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Iowa's Forests

1999-2003 Part A

aSD11.A35



Resource Bulletin
NC-266A
2006



USDA United States Department of Agriculture

Forest Service

North Central Research Station

Iowa's landscape is dominated by agriculture, but beyond the fields of corn and soybeans lie 2.7 million acres of hardwood forests owned largely by 138,000 private landowners. Iowa's forests provide critical wildlife habitat, conserve our valuable soils, and protect our streams, rivers, and lakes. Iowa's forests employ over 20,000 Iowans in the wood products industry, providing over $1 billion in annual economic activity. Our forests provide boundless opportunities for outdoor recreation, from hunting and fishing to camping and hiking. What Iowan can resist the brilliance of Iowa's trees in fall color, the fragrance of spring wildflowers in bloom, the shade of a strong maple tree in the summer, or the warmth of wood stove burning native oak during an Iowa winter day?

To understand how Iowa's forests are doing, a partnership was established between the Forest Inventory and Analysis program of the USDA Forest Service and the Forestry Bureau of the Iowa Department of Natural Resources. Using a systematic and scientific effort, the 1999-2003 report on Iowa's forests was completed. This report indicates that Iowa is gaining forestland, and that our diverse forests of oaks, hickories, maples, and many other species are healthy and growing.

But this report also shows that Iowa is losing its valuable oak trees to old age and lack of adequate regeneration as shade tolerant species such as sugar maple, basswood, and ironwood replace our sun-loving oaks. Iowa's forests also face threats from exotic insects on our borders, such as the emerald ash borer and gypsy moth, as well as stiff competition from exotic and invasive plants, such as garlic mustard and bush honeysuckle, that now outcompete the natural regeneration of our native trees and shrubs.

The results of this report will be used by the Iowa DNR Forestry Bureau in partnership with many governmental and volunteer organizations to expand sustainable forest management on private and public lands across our state. Current and new private forestland owners hold the key to the future of forests in Iowa. Please use this report to learn about Iowa's forests, to encourage the establishment of new forests, and to improve our current forests to sustain the many benefits our forests provide.



John Walkowiak, Forestry Bureau Chief

Iowa's Forests

1999-2003 Part A

USDA Forest Service
Forest Inventory and Analysis Program
Northern Research Station, St. Paul, MN

Earl C. Leatherberry, W. Keith Moser, Charles Perry, Christopher Woodall, Edward Jepsen, Steve Pennington, and Aron Flickinger

Acknowledgments

The authors thank the individuals who contributed both to the inventory and analysis of Iowa's forest resources. Staff located in St. Paul, Minnesota, involved in the 1999-2003 inventory included Dennis May, Program Manager, and Bill Burkman, Supervisor Forester. Administration office staff Barb Fuller, Tracie Hamilton, and Katrina Edwards. Staff with key responsibilities in selecting and establishing inventory plot locations included Ronald McRoberts, Mark Nelson, Dale Gormanson, Mark Hatfield, Geoffrey Holden, Dan Kaisershot, Dacia Meneguzzo, and Barb Johnson. Staff with key responsibilities in collecting the field data included Peter Koehler, Thomas Goff, Dave Haugen, Mark Jeranek, Joseph Kernan, Mark Majewsky, Ben Nurre, Ron Piva, M. Reichenberg, Gary Stachowicz, Will Smith, and Brian Wall. Staff with key responsibilities in editing field data included Barb Knight and James Blehm. Staff with key responsibilities for data management, processing, and estimation included Gray Brand, Mark Hansen, Pat Miles, Kevin Nimerfro, and Jim Solomakos. Ron Hackett and Gerhard Raile provided supply logistical services and data recorder support to field staff. Joseph Boykin reported on the first (1999) Iowa annual inventory cycle. Cassandra Olson contributed substantial time and her field knowledge to nonnative species analysis. Ron Piva conducted the timber products output study of 2000. Brett Butler generated tabular data on family forest owners from the National Woodland Owner Survey. Steve Pennington provided information about forest health conditions in Iowa. The following provided information about Iowa's forests and contributed constructive comments in manuscript review: Cassandra Olson, David Haugen, John Walkowiak, Paul Tauke, Aron Flickinger, and Wayne Fuhlbrugge.

Note: A companion (Part B) of this document, available online, contains sample design and estimation procedures, quality of estimates analysis, and core tables of forest attributes.

Foreword

In mid-continental North America, the 36 million acres of land that lie between the Mississippi River on the east and the Missouri and Big Sioux Rivers on the west are considered some of the most productive land in the world. Before Euro-American settlement, what is now Iowa was mostly prairie, with forests covering about 18 percent of the area. Settlement and agriculture transformed the landscape. Today, most land in Iowa is cultivated and forests are mostly woodlots or riparian corridors covering only 7 percent of the State. Although forest area has declined over the years, woods and wooded river bottoms are scattered throughout Iowa, providing an array of services and benefits to Iowans and visitors alike. They reduce air pollution, enhance water quality, promote plant diversity, provide wildlife habitat, produce timber, are used for recreation and relaxation, and increasingly are places where people build their homes. The services and benefits derived from Iowa's forests are important to the State's economy and contribute to the quality of life of the State's residents.

The demands placed on forest resources will continue to increase, as will biological threats from nonnative plants and insects. The challenge is to maintain Iowa's forests in such a way that they are available for use and enjoyment today and for future generations. Reporting on trends in the condition and status of forest resources is critical in determining whether they are being used or maintained in a sustainable way. The USDA Forest Service's Forest Inventory and Analysis program in partnership with the Iowa Department of Natural Resources' Bureau of Forestry inventoried Iowa's forest resources in 1954, 1970, and 1990. Beginning in 1999, annual inventories were conducted such that a portion of field plots was inventoried each year; a full inventory was completed after 5 years. The first full Iowa inventory was completed in 2003 and covers the period 1999 to 2003. Iowa's forests have much to tell us, as was stated eloquently by an author whose name history failed to record (van Buren 1938).

> *The oaks and the pines, and their brethren of the woods, have seen so many suns rise and set, so many seasons come and go, and so many generations pass into silence, that we may well wonder what "the story of the trees" would be to us if they had tongues to tell it, or we ears fine enough to understand.*

We do not presume that we can tell the full story of Iowa's forests. We recognize that the State's history is replete with stories of individual trees or groves; for example, the "plow in the oak" in Audubon County or the "lost grove" in Webster County. However, it is our hope the information provided here will stimulate discussion about the State's forest resources.

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Highlights

On the Plus Side

- Since the 1970s, forest area has increased by more than a million acres to 2.6 million, nearly matching what was present in 1954.
- Although most forest area is located in the eastern half of Iowa, some counties adjacent to the Missouri River in western Iowa and the southern tier of counties increased in forest area by as much as 10 percent between 1990 and 2003.
- Most of Iowa's forest stands are fully or moderately stocked, suggesting that in the near term, stands are capable of supplying timber for the State's wood products industry.
- Many oak-dominated stands are at the successional stage where harvest is economically advantageous.
- Annual net growth of growing stock has more than doubled since the 1980s.
- The threat of wildfire is low due to the relatively small amount of down woody debris in forest stands.

Problem Areas

- Some counties near larger urban areas declined in forest area between 1990 and 2003.
- The increasing number of shade-tolerant species could reduce tree species diversity in Iowa's forest stands as shade-intolerant species no longer are able to compete in a more shady environment.
- Forest stands dominated by oak trees contain a greater proportion of area in the older age classes.
- The lack of significant disturbances in hardwood stands has not adequately opened stands to necessary seedling development.
- Most oaks are at the age at which they are prolific seed producers, benefiting mast-eating wildlife. However, as fewer young oak move up in age class, mast-dependent wildlife species could decline.
- Absent forest management, nonstocked and poorly stocked woodlots likely will fail to reach their physical or economic potential.

Issues to Watch

- The increasing use of bio-based material from agriculture crops to produce liquid transportation fuels and biodegradable products could adversely affect the amount of forest area.
- Shade-tolerant hardwoods, primarily maples in the midstory level of stands, are replacing oaks due to an absence of stand disturbances.
- Forest succession and harvesting are slowing the overall growth of northern red oak and white oak, both of which are ecological and economically important species.
- The long-term availability of red and white oak is threatened due to oak regeneration failures. Absent silvicultural intervention, red oak and white oak will have a reduced role in the timber products industry.
- Average annual tree mortality has increased steadily since 1954. This trend likely will continue due to the threat posed by nonnative insects.
- The number of people owning forests in Iowa increased substantively during the past decade. This has resulted in the parcelization of forest ownership, woodlands removed from timber production, and the threat of reduced wildlife habitat.

The Features, Health, and Products of Iowa's Forests









Forest Features

Iowa's Forests and People

Background:

Iowa is largely a prairie State with forests found in woodlots and along stream and river bottoms. Because forests are relatively scarce, assessing change in their status and condition is important.

What We Found:

Throughout Iowa's history, the area of forests has fluctuated (fig. 1.1), reaching its nadir in the 1970s when there were only 1.6 million acres—4 percent of the State's total land area. Between 1974 and 2003, forest area increased by 1.1 million acres to 2.6 million, nearly matching the area present in 1954 (fig. 1.1). During the same time, farmland declined by 2.5 million acres (fig. 1.2). Meanwhile, Iowa's human population increased modestly from 2.6 million in 1950 to 2.9 million in 2002. During the 1950s, there was the equivalent of one acre of forest for each person living in Iowa. In the 1970s, when many farmers were plowing from fencerow to fencerow, the per capita area of forest declined to about a half acre, but has since rebounded to nearly an acre (fig. 1.3).

What This Means:

During the second half of the 20th century, forest area increased largely due to changes in the agricultural sector. Technological advancements in farming improved yields, allowing marginal lands such as that prone to erosion or flooding to be taken out of production. A decline in dairy production and an increase in feedlot use reduced the pasturing of cattle. Hardwood trees naturally recolonized many old pastures and fields, resulting in an increase in forest area. With population growth slowing, the per-capita share of forest area increased. Comparison of forest area and population suggests relative access to the services and benefits forests provide. The future trajectory of forest area in Iowa is difficult to discern, though several scenarios are possible. Demand for liquid transportation fuels such as ethanol and biodiesel from agriculture crops could increase tillage and reduce forest area. The use of corn in making biodegradable plastic containers could expand, again increasing tillage and using land to grow genetically improved, short-rotation crops for biomass could reduce forest area. When the Conservation Reserve Program ends, lands currently with trees may return to agriculture or pasture. However, in the coming decades, the demand for high-end wood products could increase, leading to an increase in oak management, a resurgence in hardwood plantings, and woodlot management.



Photo courtesy of USDA Natural Resources Conservation Service

Figure 1.1. Total forest area in Iowa, 1850-2003.

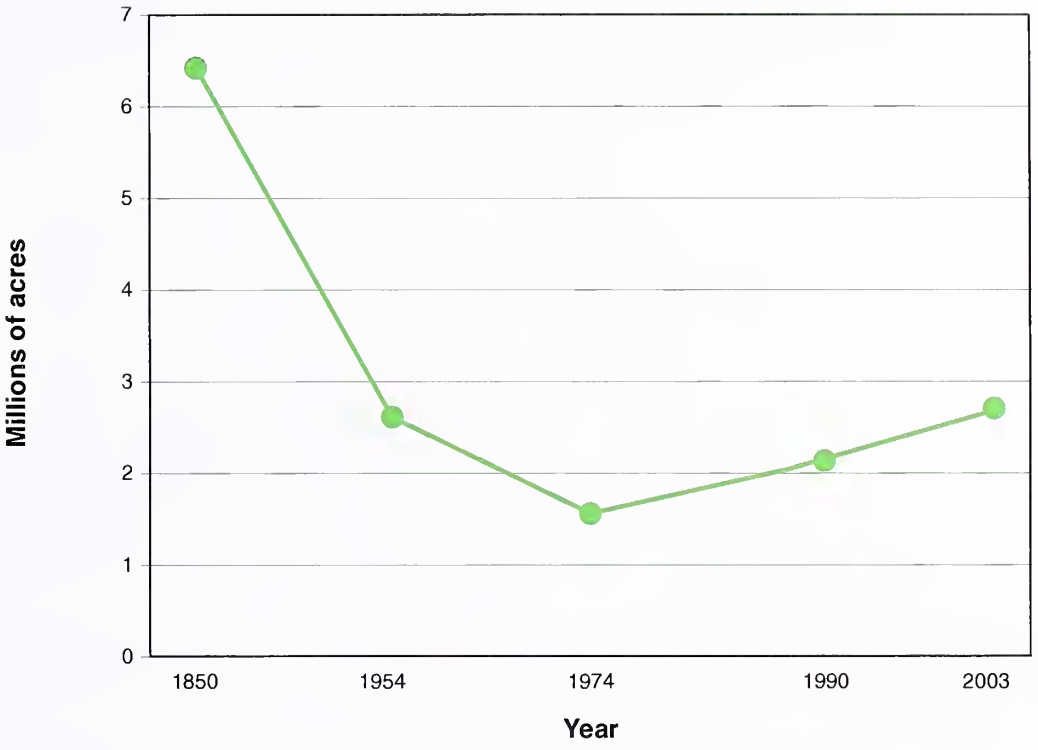


Figure 1.2. Changes in farmland and forest land in Iowa between 1974-2002 and 2003 (data on forest land were collected in 2003; farmland data were collected in 2002).

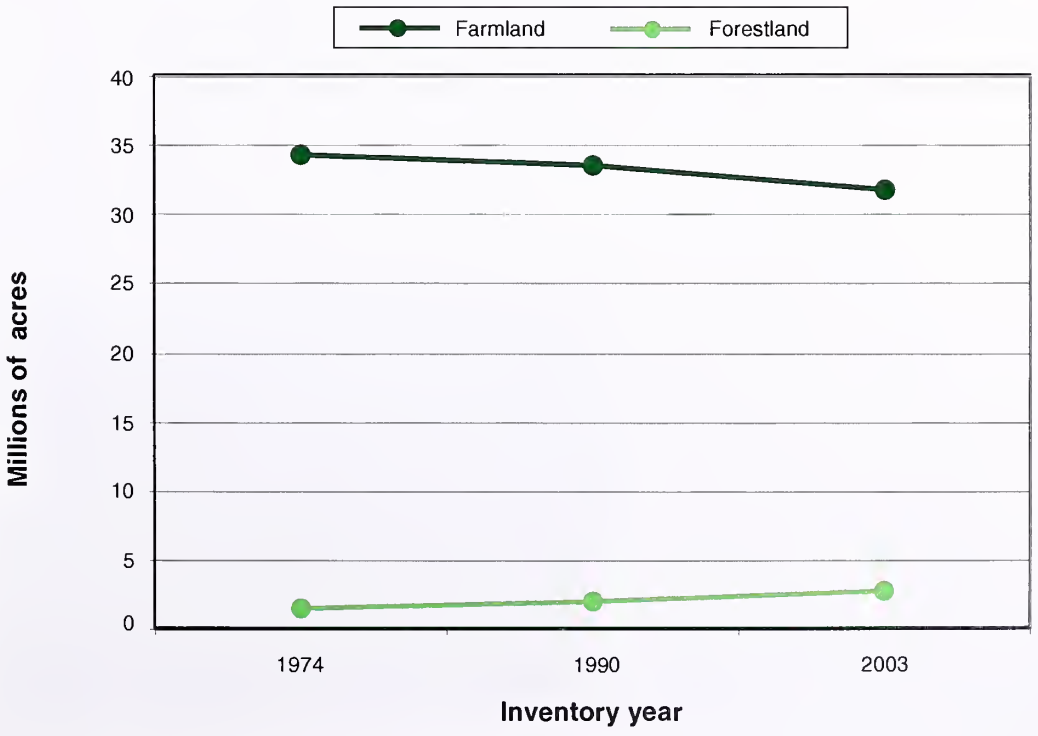
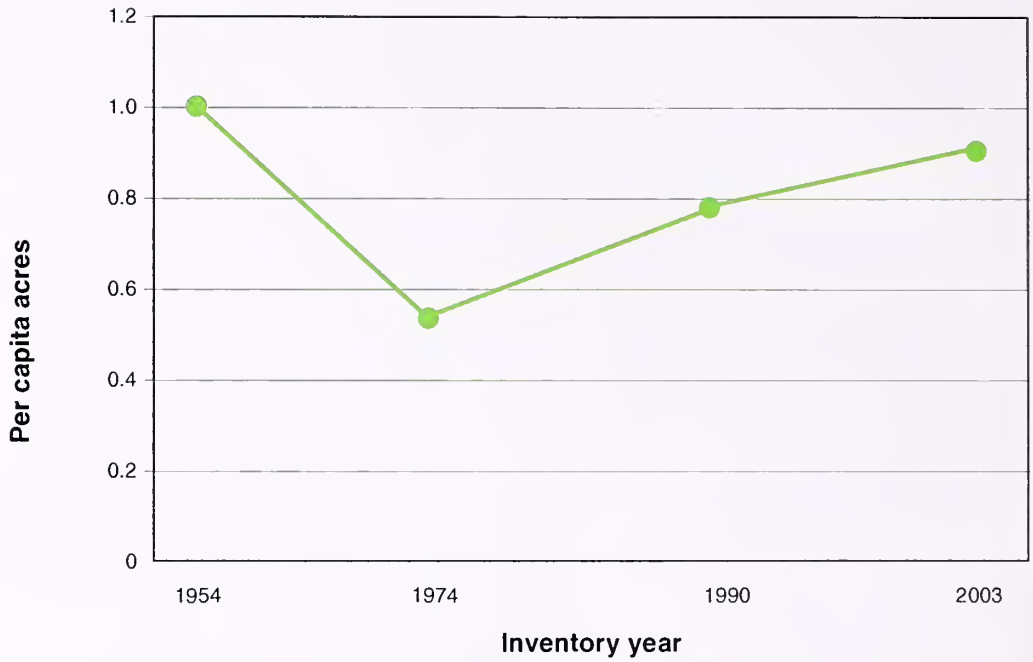


Figure 1.3. Per capita forest area in Iowa, 1954-2003.



Woodlots and Bottomland Forests—Where are They?

Background:

In the past, Iowa's forests existed where environmental conditions—temperature, wind, soil, water, and fire—converged to form optimal conditions for tree growth. In the 20th century, the actions of farmers largely dictated the location of the State's forests.

What We Found:

To describe the relative location of Iowa's forests, we divided the State into four inventory units: Northeastern, Southeastern, Northwestern, and Southwestern. Most of Iowa's forest area is in the Southeastern and Northeastern units (fig 1.4), with forest area accounting for approximately 11 percent of the land area in each unit. In the Southwestern unit, 6 percent of the land is forested versus only 2 percent in the Northwestern unit. The eastern units combined have 2.2 million acres of forest, or 83 percent of total forest area in the State. Much of Iowa's forests are concentrated in several counties in the eastern units (fig. 1.5), though forest area increased throughout the State between 1990 and 2003 (fig 1.6). Most notable were increases in forest area along the Missouri River and across the southern tier of counties. Several counties in the sphere of the urban areas of Waterloo/Cedar Falls (Fayette and Buchanan), Des Moines (Warren, Marion, and Polk), and Cedar Rapids and Iowa City (Linn, Jones, and Johnson) experienced a net loss of forest area between 1990 and 2003.

What This Means:

In western Iowa, where precipitation is lower and the weather can be harsh and extreme, woodlots are rare and most forests are found along protected sections of stream or river bottoms. In eastern Iowa, greater precipitation and less extreme weather are more conducive to tree growth. Rivers are larger with more extensive riparian forests, and farmers tend to own woodlots as part of their holdings. In the Northeastern unit, forests are common on slopes that preclude agricultural activities. Much of the increase in forest area in the Southeastern unit resulted from old pastures becoming forest area. In former pastures, established trees along with new growth often qualified as forest. In some bottomland areas, forests became established through plantings or natural regeneration. In eastern Iowa, some woodlots are being converted to housing developments. Improved roads and interstate highway corridors likely will lead to the creation of additional home sites from woodlands.



Photo courtesy of USDA Natural Resources Conservation Service

Figure 1.4. Forest area by forest resource unit, Iowa, 2003.

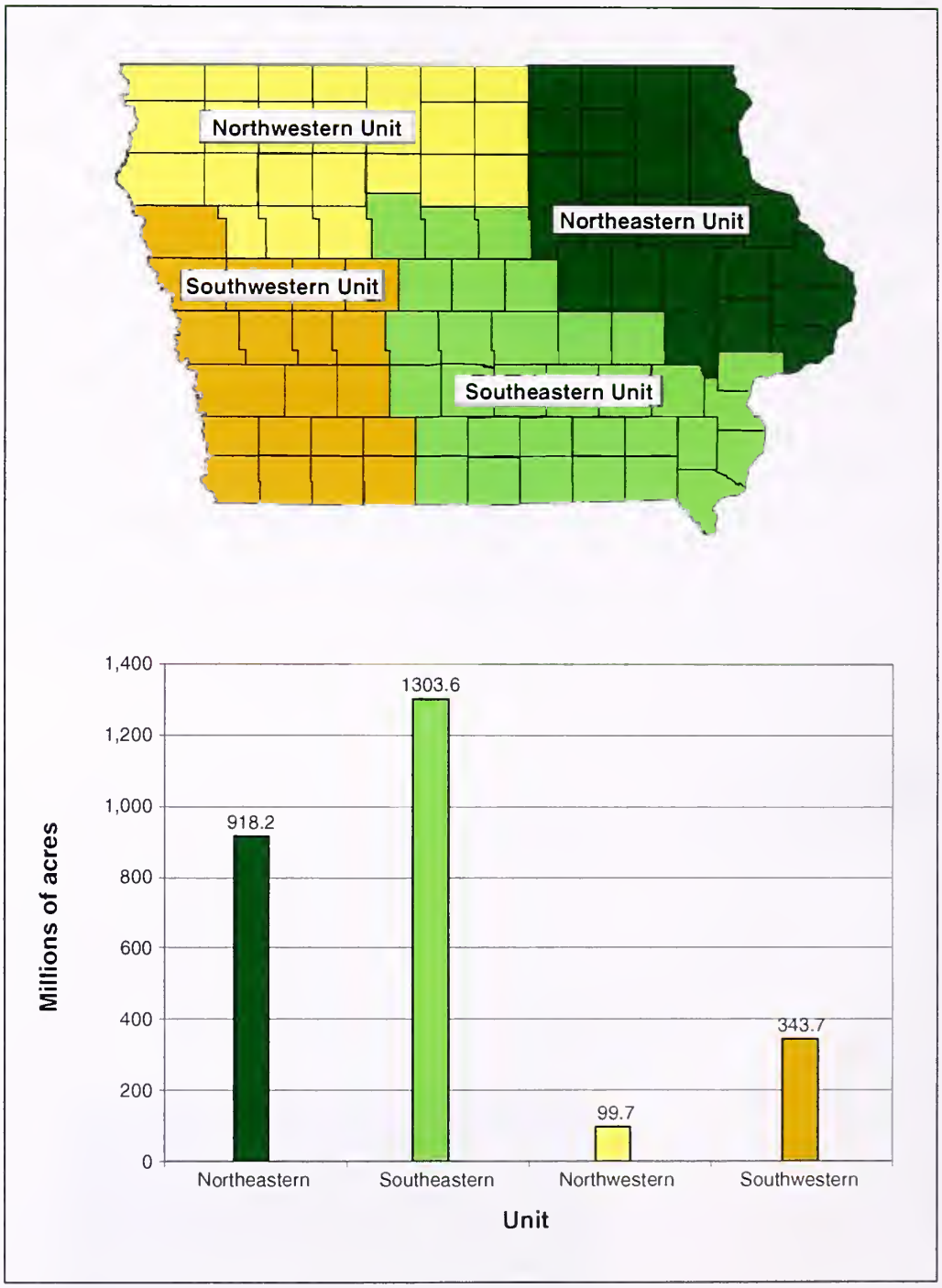


Figure 1.5. Percentage of forest area by county, Iowa, 2003.

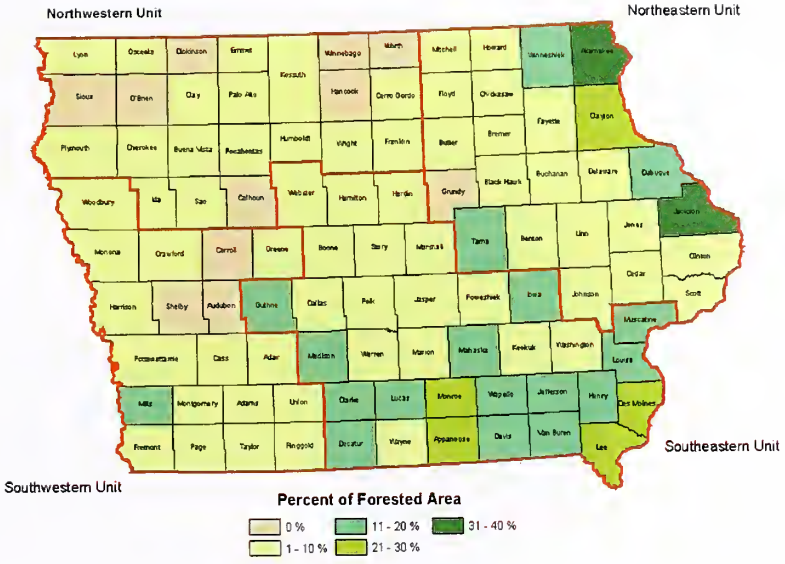
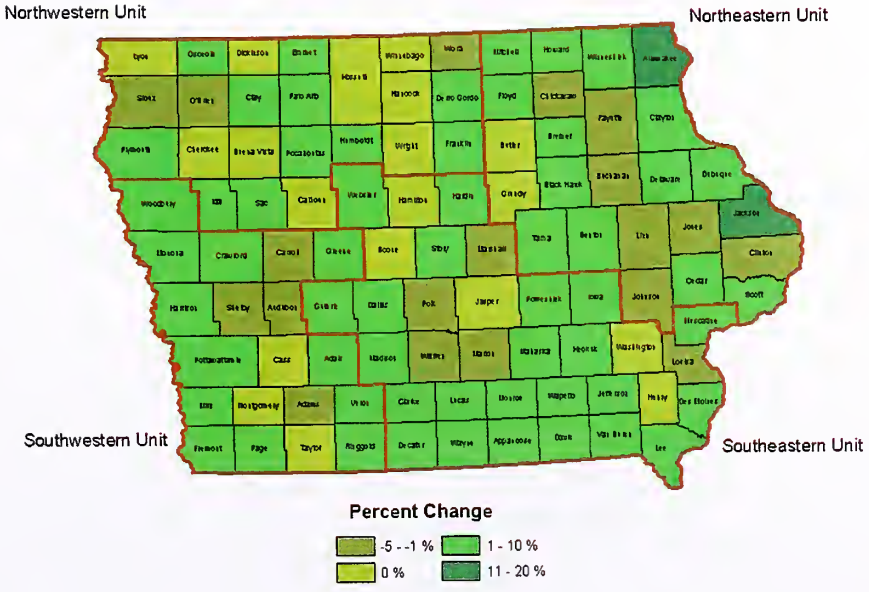


Figure 1.6. Change in forest area as a percentage of total land area in Iowa, 1990-2003.



Forest Tree Diversity

Background:

Trees of a particular species tend to grow together because they have similar growth characteristics and site requirements. A single species can dominate a stand or a stand may comprise a mix of species. Identifying forest species provides information about forest succession, wildlife habitat, wood potentially available for products, and the need for silvicultural applications (stand improvements).

What We Found:

Iowa's forest stands contain just over a billion trees growing among 68 species of forest trees. Hardwood or deciduous trees occupy 97 percent of Iowa's forest area. Oak/hickory forests are the most extensive (fig. 1.7) and include mostly white oaks, northern red oaks, bur oaks, and a mix of upland hardwoods trees. Softwood or conifer dominant stands cover only 1 percent of the forest area in Iowa. However, softwoods, primarily eastern redcedar, are mixed with hardwoods in the eastern redcedar/hardwood forest type. Between 1990 and 2003, the number of forest trees increased by 21 percent. American elm is the most abundant tree in Iowa, accounting for 14 percent of total live forest trees (fig. 1.8). Maples, including boxelder, are the second most abundant forest tree species in the State. Between 1990 and 2003, maples increased by nearly 50 percent, accounting for 11 percent of total trees. Eastern hophornbeam, a small, short-lived tree that grows beneath other trees, also increased in number and now accounts for 10 percent of total forest trees. White and northern red oaks declined by 11 and 18 percent, respectively, while shingle and bur oak increased. As a group, oaks remained about the same, accounting for 10 percent of total trees.

What This Means:

The oak/hickory forest dominates, but the elm/ash/cottonwood forest type group and the maple/beech/birch forest type group have a significant presence. The maple/beech/birch group, consisting primarily of shade-tolerant trees, is increasing. Oaks are shade intolerant and in some stands, sugar maple and other shade-tolerant species form a dense layer in the understory, leaving fewer openings for oak regeneration. This is especially true of red and white oak, both of which declined between 1990 and 2003. However, shingle oak, found mostly in southeastern Iowa, and bur oak, found throughout the State, increased. American elm accounts for 14 percent of forest trees, though the effects of Dutch elm disease limit its ability to dominate. The increasing number of shade-tolerant species could reduce tree species diversity in Iowa's forest stands as shade-intolerant species no longer can compete in a more shady environment.

Figure 1.7. Area of timberland in Iowa by forest type group, Iowa, 2003.

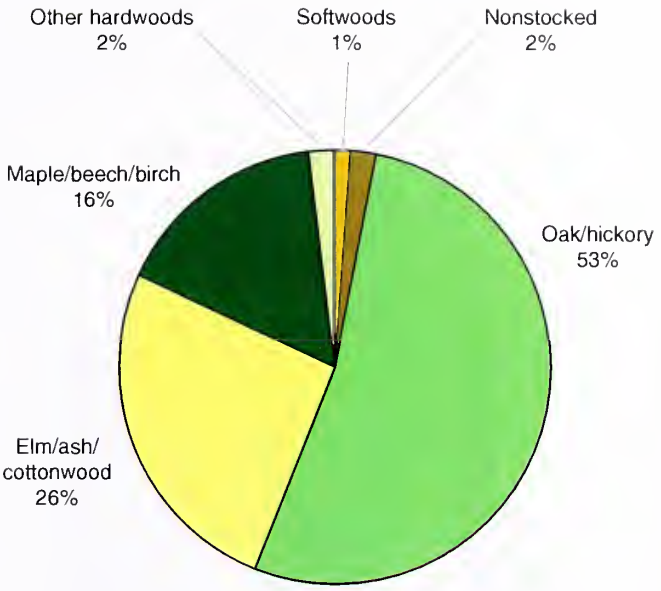
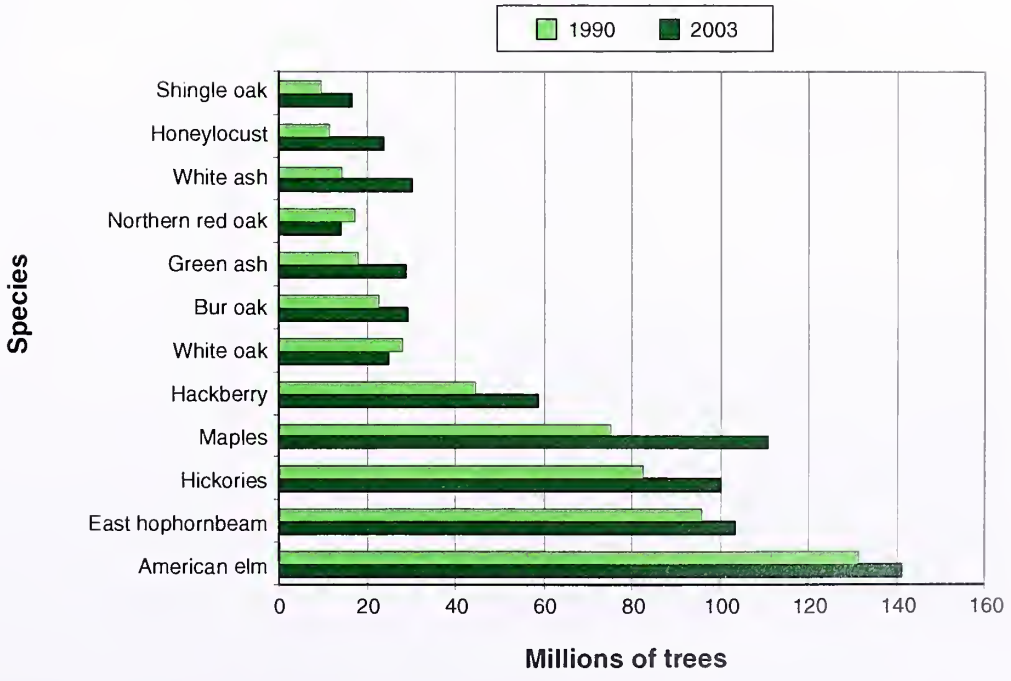


Figure 1.8. Number of all live trees by selected species and groups of species, Iowa, 1990-2003.



Large Trees are Predominant in Iowa's Woods

Background:

Forests generally contain trees of various sizes. Stand size is a measure of the average diameter of the dominant trees in a stand, measured at 4.5 feet above ground, commonly called diameter at breast height (d.b.h.). There are three stand-size classes: sawtimber—large trees, softwoods at least 9 inches in d.b.h. and hardwoods at least 11 inches d.b.h.; poletimber—medium trees, 5 inches in d.b.h. to sawtimber size; and sapling/seedling—small trees, 1 to 5 inches in d.b.h. Tracking change in the distribution of stand-size class provides information about forest sustainability and succession, wood potentially available for products, wildlife habitat, and recreation potential.

What We Found:

Sawtimber-size stands continue to predominate in Iowa's forests (fig. 1.9). Since 1954, the area of sawtimber has increased by 64 percent and now occupies 1.7 million acres, or nearly two-thirds of the forest area. At the same time, the area of poletimber-size stands first declined but then increased, currently occupying 603,000 acres, or 23 percent of the forest area. The area of sapling-seedling stands has remained fairly stable in recent years, occupying 307,000 acres, or 11 percent of the forest area. Three percent of the forest area is nonstocked. Forest types with a preponderance of area in the sawtimber size class include northern red, bur, and white oaks, silver maple, and American elm (fig. 1.10). Conversely, nearly half the area of the eastern redcedar and eastern redcedar/hardwood types are in sapling/seedling-size stands.

What This Means:

Over the years, forest trees in Iowa generally have grown larger. The high proportion of total area in large-diameter trees indicates a maturing hardwood forest. The expanding area of sawtimber stands suggests that timber harvesting or other disturbances are reducing few stands to early successional stages. In the past, timber harvesting was by selective cutting or high-grading. The lack of significant disturbances in hardwood stands has not opened stands to progressive seedling development. Some smaller trees are prevented from maturing properly by large overstory trees, as suggested by the static nature of sapling-seedling stands since the 1970s. Between 1990 and 2003, the area of poletimber-size stands in the sugarberry/hackberry/elm/green ash, and elm/ash/locust types increased, suggesting recruitment of sapling-seedling trees into the larger class. Trees associated with those forest types typically are found on bottomland sites, pointing to an expanding lowland forest. The relatively high proportion of sapling-seedling area in the eastern redcedar and eastern redcedar/hardwood types indicates that eastern redcedar typically is the first tree species to become established in abandoned fields and old pastures.



Paul Wray, Iowa State University, www.forestryimages.org

Figure 1.9. Area of timberland by stand-size class, Iowa, 1954-2003.

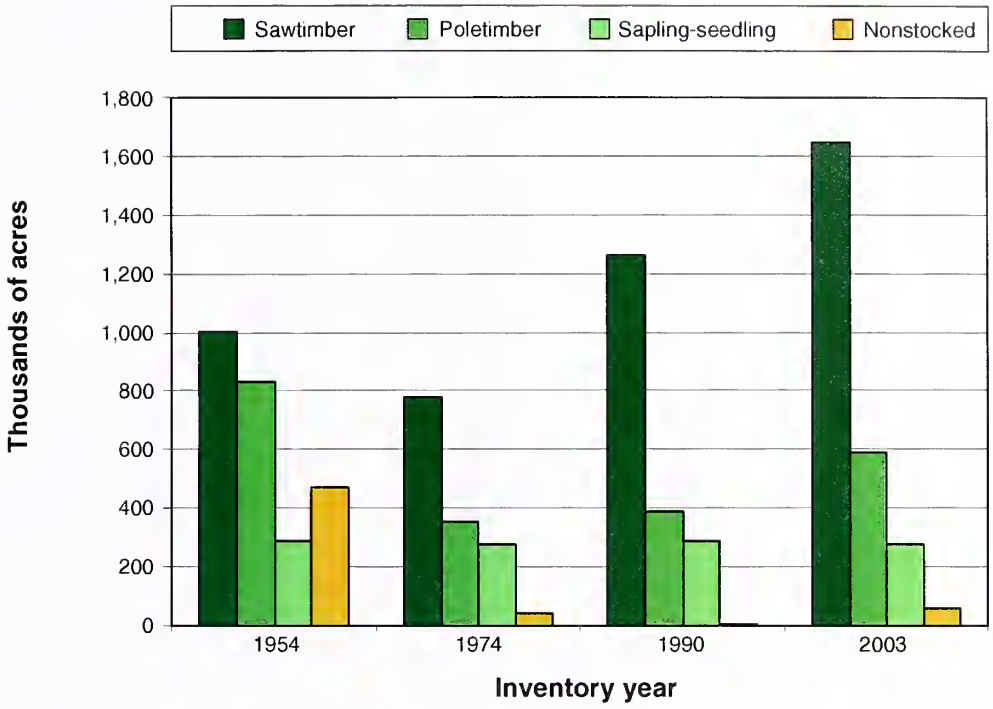
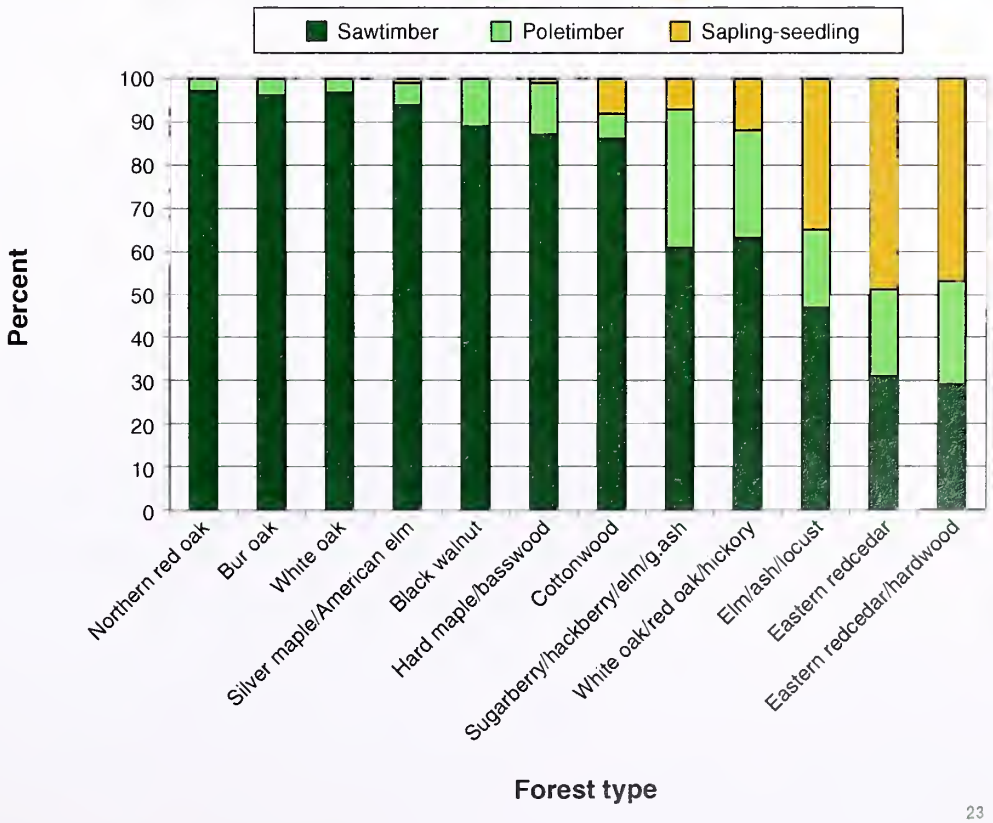


Figure 1.10. Percentage of select forest types by stand size class, Iowa, 2003.



Forest Stand Age

Background:

Iowa's forest stands vary in age. Age is estimated based on core samples from dominant or codominant trees from the overstory of a stand. Estimating age is important because it provides information about successional development of forest stands and, in turn, its capacity for delivering ecosystem services and wood products. For instance, a forest equally divided between age classes likely will yield an even flow of timber for wood products. A forest with trees of various ages also is important in maintaining diversity in forest wildlife populations and for esthetic enjoyment.

What We Found:

Forest stands in Iowa can be grouped into three broad age categories: 1 to 40 years old, 41 to 80 years old, and 81+ years old. Since 1974, the area of timberland in stands between age 41 and 80 has been expanding and currently accounts for 55 percent of timberland area, up from 38 percent of total in 1974, or more than a half million additional acres (fig. 1.11). Between 1990 and 2003, stands dominated by trees older than 80 years declined in area by 11 percent, or more than 120,000 acres. As a proportion of forest area, younger stands remained fairly stable, increasing by 220,000 acres between 1990 and 2003. Stand age varies by species. In 2003, stands dominated by oak trees contained a greater proportion of area in the oldest age class (fig. 1.12). Non-oak hardwood stands generally are younger. Because of its commercial value, black walnut seldom grows into the older age class. Stands with a significant number of eastern redcedar account for only 3 percent of forest area, but most of them are young.

What This Means:

Most of the stands in Iowa's forests are more than 40 years old; oak stands generally are older. Most oak stands came into existence and were maintained by disturbances such as fire and timber harvesting, both of which promote regeneration by allowing sunlight to reach oak seedlings on the forest floor. In the absence of stand disturbances, shade-tolerant hardwoods (e.g., maples) in the midstory are replacing oaks. The age distribution of oaks has important implications for Iowa's timber products industry and woodlot owners' personal income from harvesting. With fewer large, high-quality oaks likely to come from Iowa's woodlots, income and value-added economic activity will decrease. Further, certain wildlife species would be adversely affected by fewer oaks. Generally, older oaks are prolific seed producers, benefiting mast-eating wildlife. However, as fewer young oaks move up in age, these wildlife species could decline.

Figure 1.11. Distribution of timberland by stand age class, Iowa, 1974-2003.

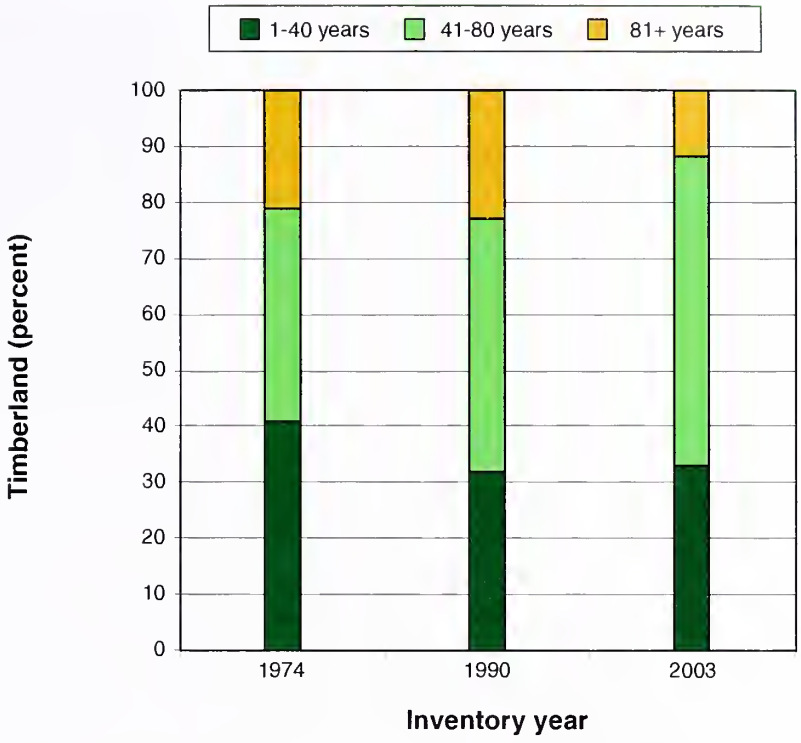
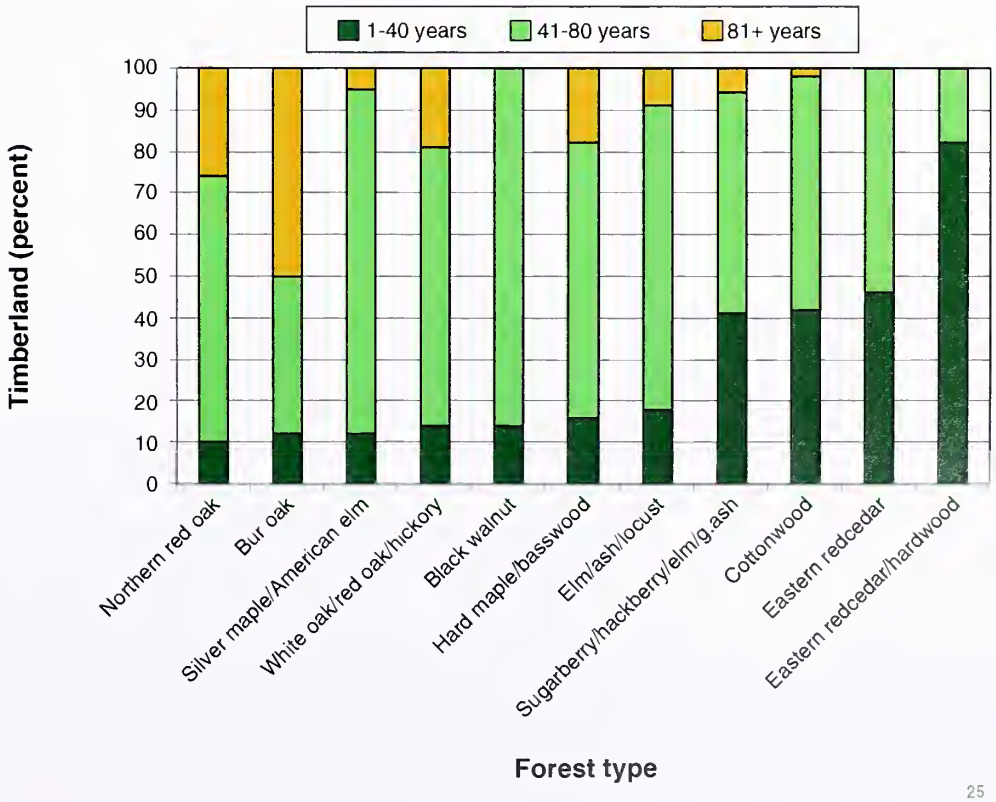


Figure 1.12. Distribution of proportion of area for selected forest types by age class, Iowa, 2003.



How Dense are the Woods?

Background:

The extent to which trees occupy woodlots and river corridors indicates the stage of stand development and suggests the potential array of benefits that might be derived. For instance, stand density can be an indicator of the need for harvesting trees or other activities that promote growth in stands.



Photo courtesy of USDA Forest Service, Northeastern Area, State and Private Forestry

What We Found:

We used three features of stands to derive measures of density: number of growing-stock trees per acre of timberland, growing-stock volume per acre of timberland, and percentage of timberland by stocking class. The average number of growing-stock trees per acre of timberland increased between 1954 and 1990, but decreased between 1990 and 2003 (fig. 1.13). Meanwhile, the average volume of growing stock per acre of timberland increased each inventory year, more than doubling between 1954 and 2003 (fig. 1.14). Stocking, a relative measure of tree density, is used to describe how fully trees occupy stands. Most of the timberland is in the fully stocked (22 percent of all timberland) or moderately stocked (33 percent) categories (fig. 1.15). A stand is considered fully stocked when trees occupy the amount of space in a stand that creates conditions for the best growth and form. About one-third of Iowa's timberland area is poorly stocked. Such stands contain insufficient good growing trees per acre to fully utilize the site. Nonstocked timberland, 11 percent of the State's timberland area, represents stands in which stocking of live trees is less than 10 percent.

What This Means:

The decrease in the average number of growing-stock trees per acre and the corresponding increase in average volume per acre point to a mature forest with trees that are fairly well spaced and that have good growth characteristics. In a mature forest, the decline in number of growing-stock trees per acre suggests optimal site occupancy. On the better sites, more favorable growing conditions allowed certain trees to gain early dominance, thus reducing the number of competing trees. The remaining trees grow more vigorously than those on poor sites and add additional volume over the same period. Paradoxically, many woodlots are nonstocked or poorly stocked. This can be explained by several concurrent activities that affect stand development in Iowa's woodlots: (1) agricultural lands reverting to forests—stocking densities in those woodlots usually are low, (2) livestock grazing reduces stocking, and (3) overcutting. Most of Iowa's woodlots are

fully or moderately stocked, suggesting that for the near term, stands are capable of supplying timber for the State's wood products industry. Many oak-dominated stands are successional and at the stage where harvesting is economically advantageous. However, to meet timber demands over the longer term, forest management should focus on encouraging forest owners to improve stocking in the poorly stocked and nonstocked woodlots. Absent forest management, nonstocked and poorly stocked woodlots likely will fail to reach their physical or economic potential.

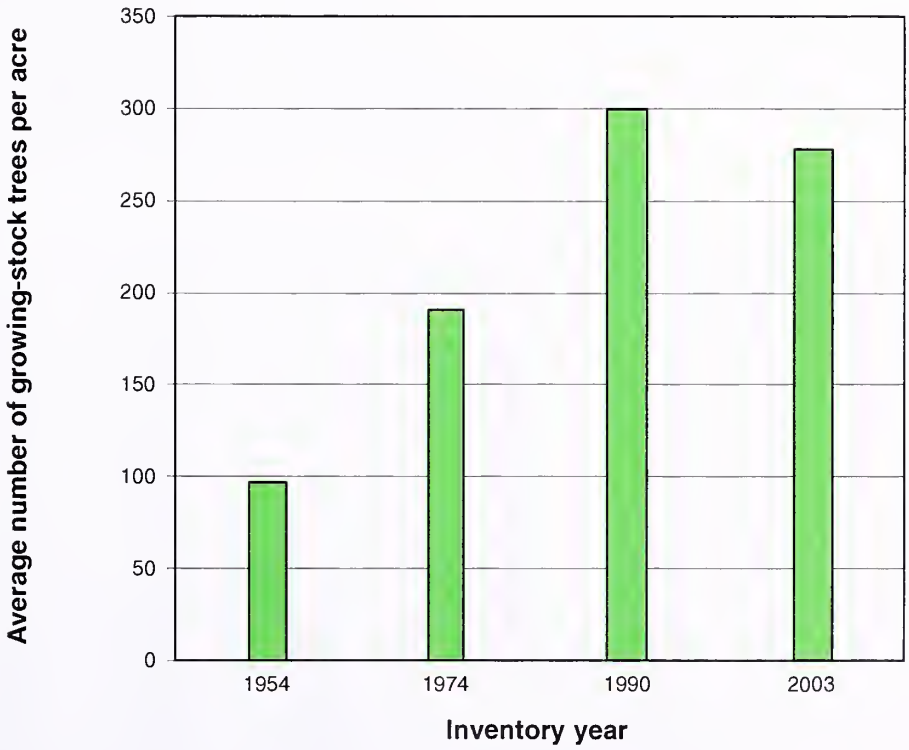


Figure 1.13. Average number of growing-stock trees per acre of timberland, Iowa, 1954-2003.

Figure 1.14. Average volume of growing stock per acre of timberland, Iowa, 1954-2003.

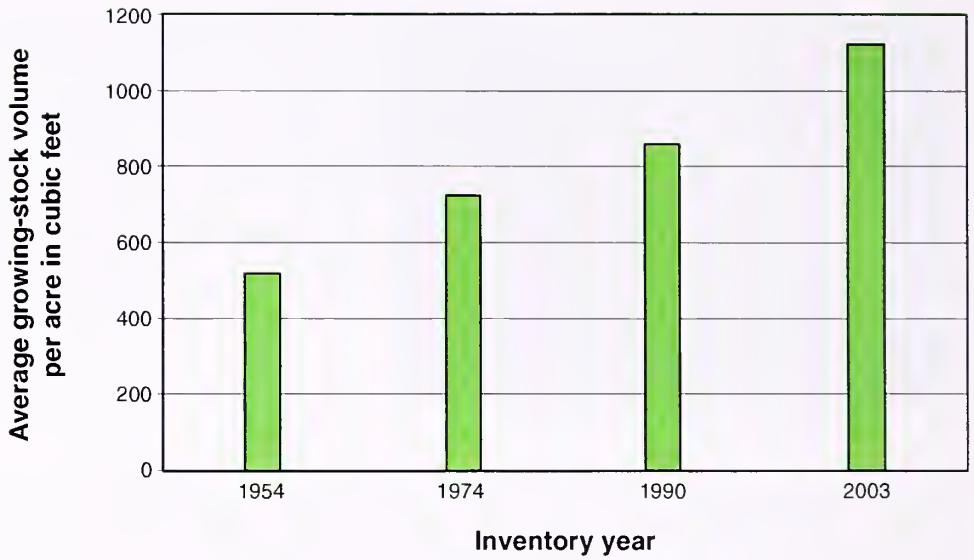
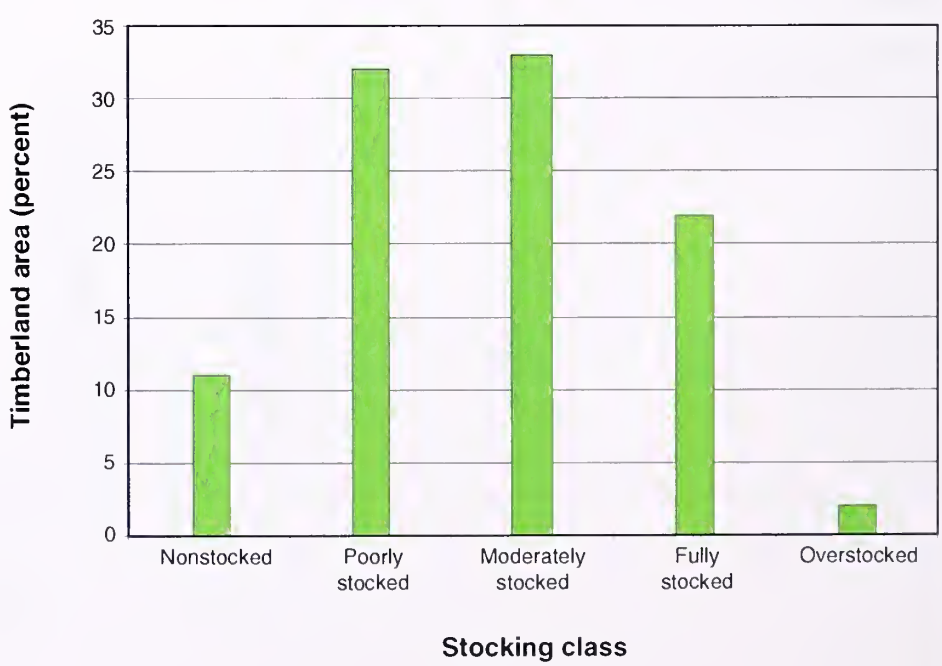


Figure 1.15. Percentage of timberland by stocking class, Iowa, 1999-2003.



Biomass: The Whole Tree

Background:

Tree biomass is the total dry weight of all live aboveground components of forest trees. These include boles, stumps, tops, and limbs. In commercial timber harvesting, the bole usually is the primary product because it contains wood used as lumber or veneer. Biomass estimates are increasing in importance for analyses of carbon sequestration, fiber availability for fuel, and fuel loads in stands. As new industries emerge around the production of bio-based products (e.g., biocomposites and biofuels), residual biomass from forest thinning and timber harvest take on added environmental and economic importance.

What We Found:

Live aboveground tree biomass exceeds 106.6 million dry tons, an average of about 40 dry tons/acre of forest area. Total aboveground tree biomass increased by 27.3 million dry tons between 1990 and 2003. The bole—the trunk or main stem of trees—accounts for nearly 7 of every 10 dry tons of forest-tree biomass. Stumps, tops, and limbs account for one-fourth of biomass followed by small trees (1 to 5 inches) at 6 percent of all live aboveground tree biomass (fig. 1.16). Eighty-seven percent of total aboveground biomass is on privately owned woodlots (fig 1.17), though on a per-acre basis, biomass tends to be greater on public than on private forests (fig. 1.18).

What This Means:

In Iowa, the average acre of forest has about 40 dry tons of aboveground live-tree biomass. How much is 40 dry tons of tree biomass? On average, corn stover—corn harvest residues consisting of dried stalks, leaves, husk, and cobs—range from 3 to 4.5 dry tons/acre in fields producing 100 to 150 bushels of corn/acre. The typical forest acre in Iowa has roughly 10 times as much dry biomass as an acre of corn following harvest. The difference is that tree biomass is live while corn harvest residue is not. The increase in tree biomass is attributable to the increase in forest area and growth on trees. On private woodlots, where biomass per acre is about 18 percent lower than on public forests, increases in biomass could be an important income producer as carbon trading emerges as a major vehicle for mitigating greenhouse gases.

Figure 1.16. Distribution of components of live-tree biomass, Iowa, 1999-2003.

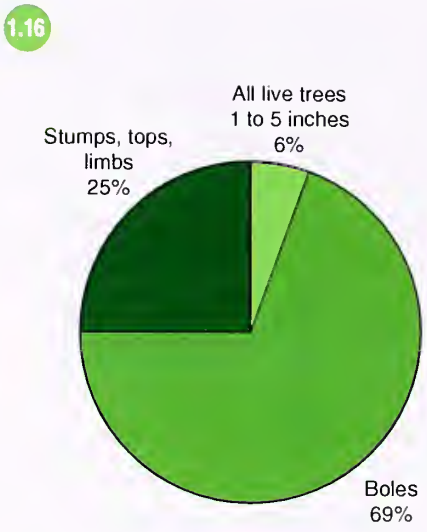


Figure 1.17. Ownership of forest biomass (dry tons) for growing-stock and non-growing-stock trees on timberland, Iowa, 1999-2003.

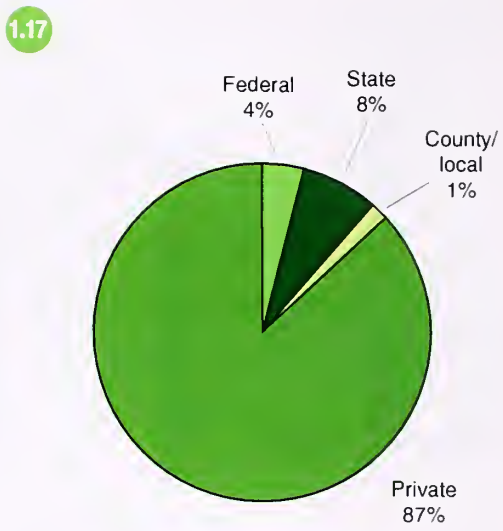
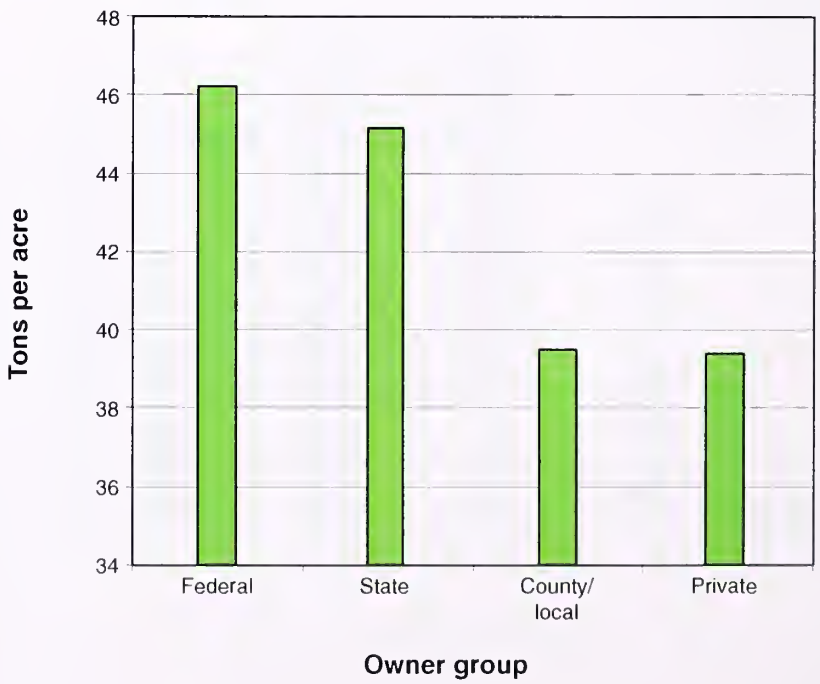


Figure 1.18. Per-acre aboveground dry weight of all live-tree biomass by owner group, Iowa, 1999-2003.



Forest Growth

Background:

The capacity of woodlots to grow wood volume is an indicator of health, vigor, and development stage of trees in stands. Forest growth is expressed as average annual net growth. Net growth is gross growth minus mortality. Averaged annual net growth is based on the average growth rate between 1990 and 1999 to 2003, the years between the two most recent inventories.

What We Found:

Average net annual growth of growing stock has increased substantially since 1990 and now is 117.5 million cubic feet (ft^3) per year (fig. 1.19). Between 1990 and 2003, an average of 46 ft^3 of wood was added to each acre of timberland each year, predominantly in mature trees. As a result, average growing-stock volume per acre of timberland had more than doubled since 1954, increasing from 532 to 1,112 ft^3 in 1999-2003. Hardwood growth accounts for 98 percent of the total average annual growth of growing stock. Between 1991 and 1999-2003, eight species led by silver maple and bur oak experienced growth that combined accounts for two-thirds of net annual growth (fig. 1.20). Silver maples produced the largest portion of growth (13 percent of total growth) followed by bur oak (12 percent), and black walnut and eastern cottonwood (8 percent each).

What This Means:

Iowa's forest stands currently are growing wood at increased rates. The rate for silver maple, a prolific seed producer that grows rapidly, exceeds all other species. Second is bur oak, a hardy species that can endure weather extremes and many of the maladies that affect other oak. Established cottonwoods continue to put on substantial annual growth and black walnut, a high-value wood, is managed for growth. However, growth rates for northern red and white oak are slowing. Both species are economically important so this slowing has implications for their future role in the State's timber products industry. To ensure that red and white oak are available for commercial wood products, owners should be encouraged to manage these species for regeneration and growth.

Figure 1.19. Average annual net growth of growing stock per inventory reporting period, Iowa, 1954 to 1999-2003.

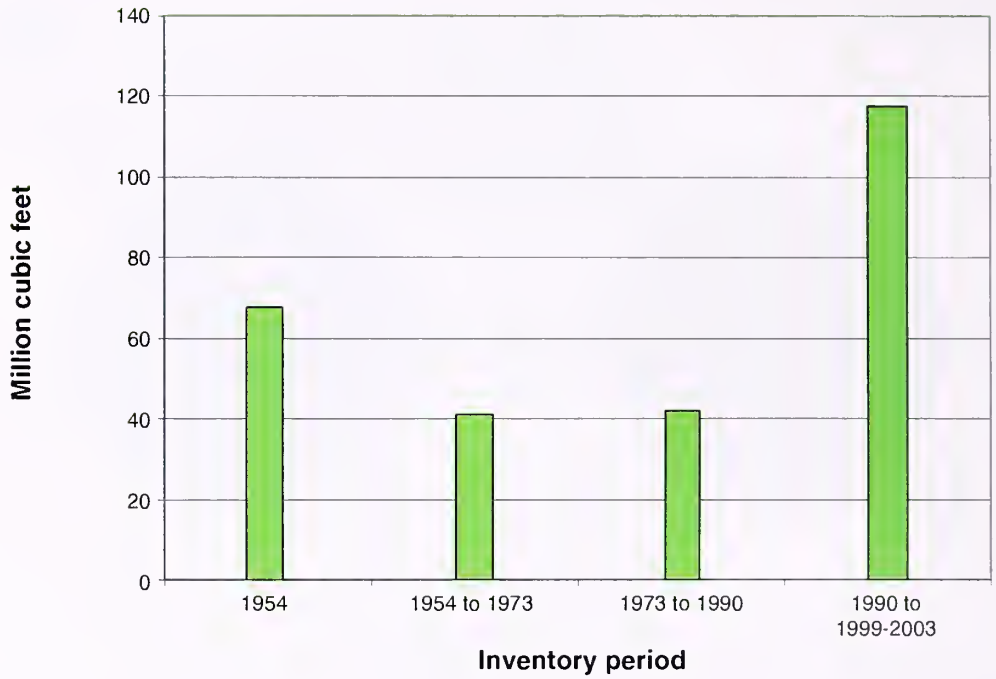
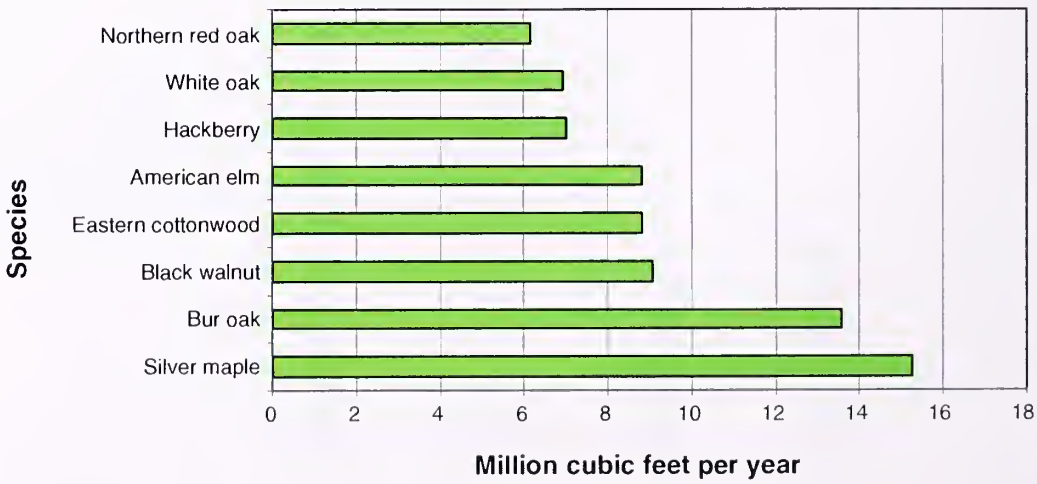


Figure 1.20. Average annual net growth of growing stock on timberland for selected species, Iowa, 1990 to 1999-2003.



Forest Tree Removals

Background:

The amount of wood volume removed annually from woodlots is an indicator of wood consumption and forest resource sustainability. Wood volume is removed from stands through timber harvesting, cultural operations (e.g., timber-stand improvement), land clearings, and changes in land use.

What We Found:

Tree removals volume averaged 50.3 million ft^3 between 1954 and 1973 (fig. 1.21). From the early 1970s into the late 1980s, annual average removals declined to 22 million ft^3 and then rose to 25.5 million ft^3 from 1999 to 2003. Between 1955 and 1974, tree removals exceeded net annual growth. As a percentage of total tree volume, the removal rate has dropped steadily since the 1950s (from 4.8 percent to 0.9 percent today).

The percentage change in annual average removal rates among species over the two most recent inventory periods has been highly variable, e.g., black walnut (439 percent), northern red oak (124 percent), silver maple (-20 percent), white oak (-42 percent), and eastern cottonwood (-58 percent). From 1991 to 2003, virtually all removals were hardwoods. Softwood removals totaled 250,000 ft^3/year, or about 1 percent of the total. Virtually all removals (24.5 million ft^3/year) were from privately owned forests. Northern red oaks had the largest average annual removals at 6.2 million ft^3/year, nearly one-fourth of total removals (fig. 1.22).

What This Means:

Land clearings and changes in land use always have been a significant component of removals. During the 1950s and 1960s, most removals resulted from woodlots being cleared or opened to grazing, and river bottom stands being cleared for row-crop agriculture. Since the mid-1970s, the agriculture land base has stabilized with a slight decline while the volume of wood removals has declined to less than 1 percent of total tree volume. Black walnut experienced a substantial increase in removals to meet the market demands for its wood. White oak removals continued to decline while northern red oak removals more than doubled (about one-fourth of all removals). The latter removals are relatively large because red oak is valued and much of the resource is at economic maturity. However, the relatively large volume of this species being removed is cause for concern about the long-term availability of red and white oak due to the lack of small trees and regeneration failures. Red and white oak are the life blood of Iowa's timber products industry and a shortage of quality oaks would adversely affect the industry.

Figure 1.21. Average annual removals of growing-stock volume, Iowa, 1954 to 1999-2003. Values represent average annual removals for the period since the previous inventory.

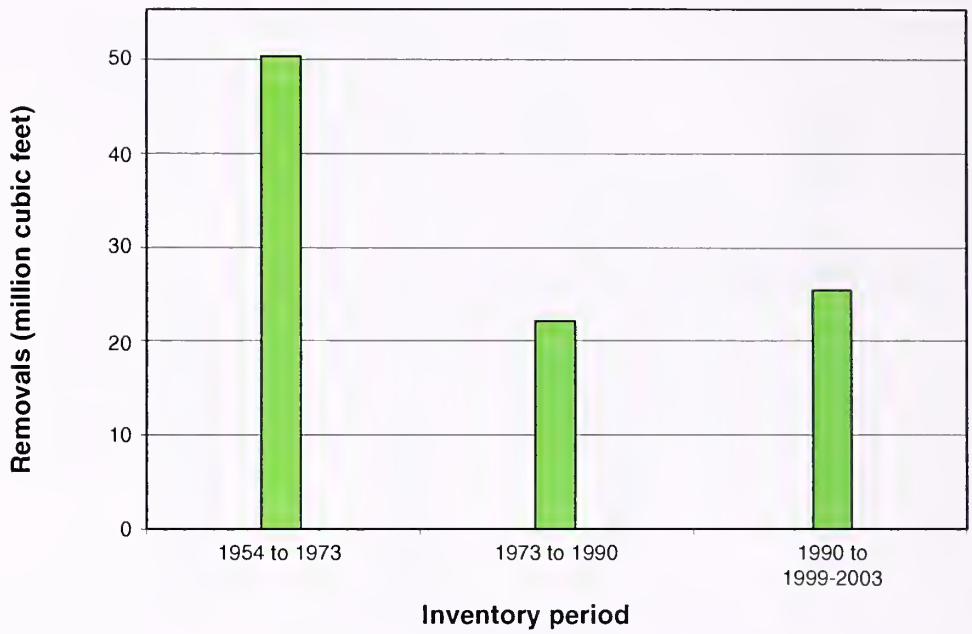
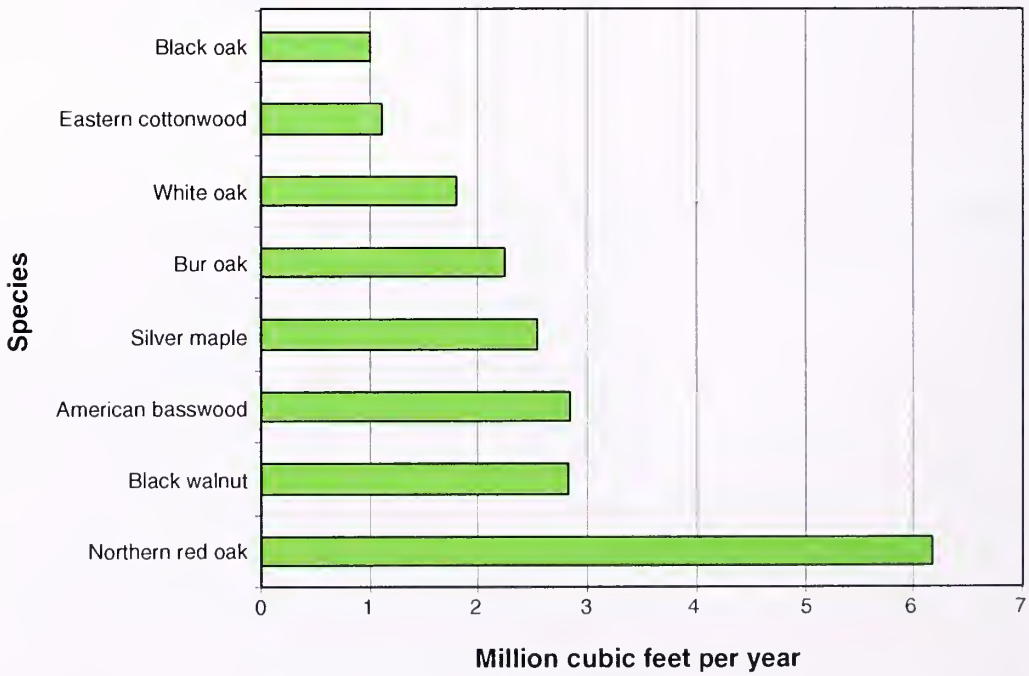


Figure 1.22. Average annual removals of growing stock on timberland for selected species, Iowa, 1990 to 1999-2003.



Forest Tree Mortality

Background:

Tree mortality is caused by factors such as disease, insect attack, physical damage, weather, climatic change, and old age—often in combination. Mortality volume is the volume of wood in trees that died from natural causes. It does not include volume removed by human action, e.g., from harvesting.

What We Found:

The average annual mortality increased steadily between 1955 and 2003, reaching 24.5 million ft^3, nearly a threefold increase (fig. 1.23). Between 1990 and 1999 to 2003, American elm had the largest average annual mortality at 2.9 million ft^3, followed closely by silver maple and eastern cottonwood (fig. 1.24). Those species combined accounted for more than one-third of total average mortality between 1990 and 1999-2003. Mortality in northern red oak and white oak is fairly low, though black oak mortality exceeds 2 million ft^3/year. The average annual mortality for black walnut is nearly 2.5 million ft^3/year.

What This Means:

The amount of mortality associated with American elm is the result of Dutch elm disease, which has expanded throughout the State. Black oak mortality is primarily the result of oak wilt and oak decline. The widespread flooding of 1993 was especially damaging. Trees submerged in water for weeks were stressed and weakened, rendering them susceptible to disease and insect attacks. Mortality rates likely will increase in the near term because Iowa's woodlots contain many older trees, and could be accelerated by non-native insects or pathogens, including gypsy moth and emerald ash borer.

Figure 1.23. Average annual mortality, Iowa, 1954 to 1999-2003.

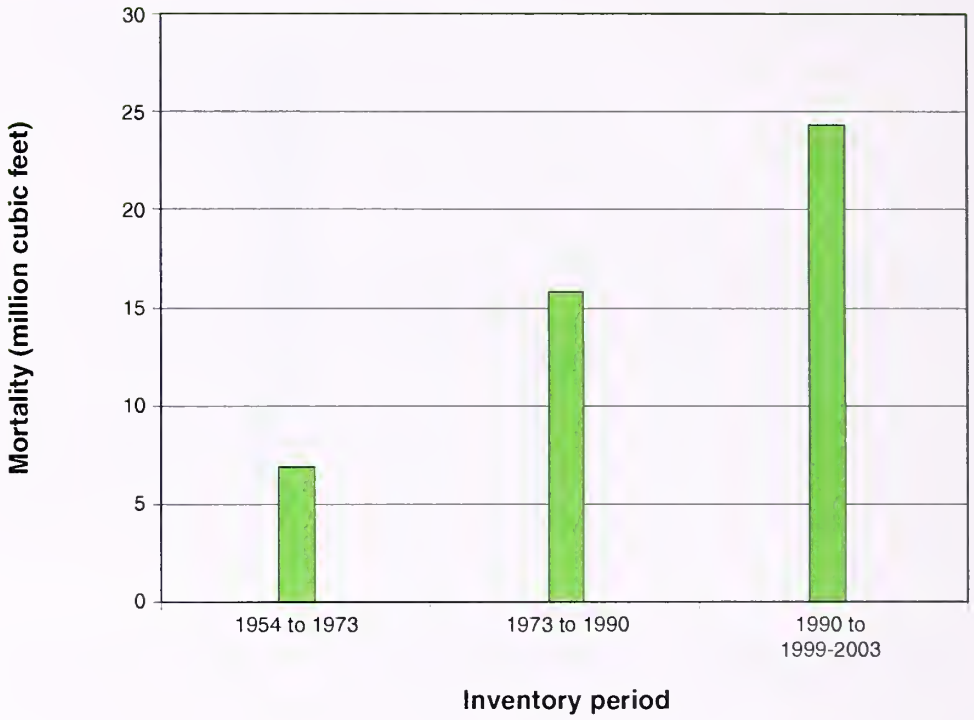
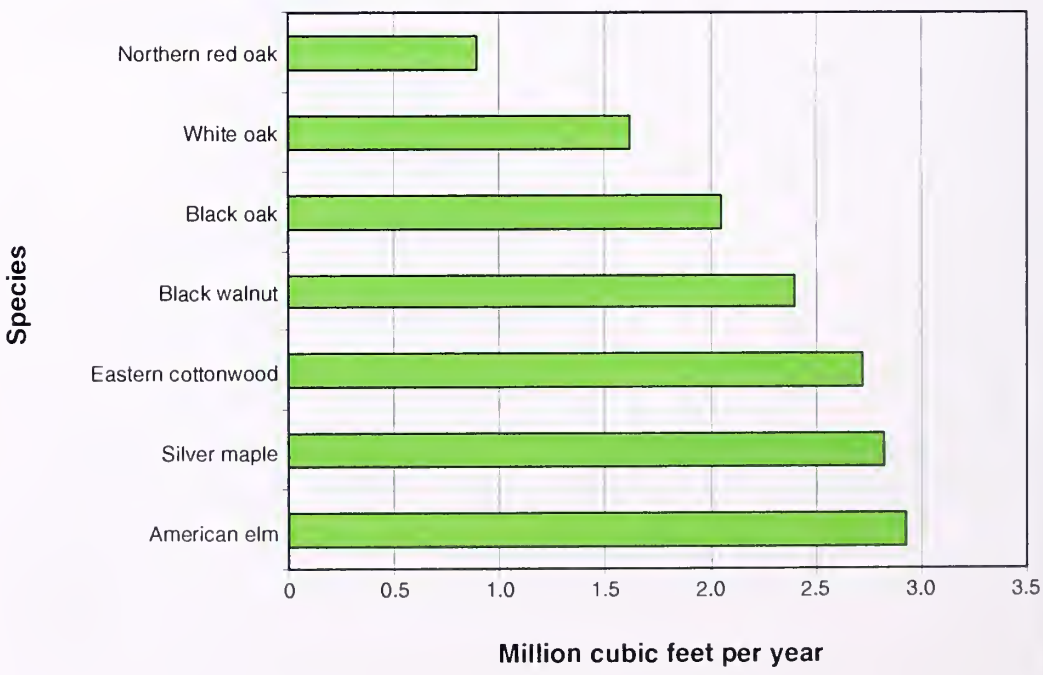


Figure 1.24. Average annual mortality of selected species, Iowa, 1999-2003.



Oaks—A Special Situation

Background:

Oaks are special to Iowans—the oak (no specific species) is designated as the State tree. Northern red and white oaks are the premier species in the State's wood products industry. Oaks provide mast and habitat for numerous bird and mammal species, and are revered for their stately presence. However, as we have chronicled here, over the last century the cumulative impacts of human actions have changed Iowa's forests. Once dominated by oaks, these forests are in transition as the number of northern red and white oak trees has declined. Stands of oaks have an inordinate amount of area in larger trees—more than 95 percent of the stands where red and white oak are a plurality are composed of large-diameter trees. Many of these stands contain trees that are more than 80 years old. Northern red oak is being removed at a rate that far exceeds that of other species. Indeed northern red and white oaks are at a juncture where their continued strong presence on the landscape is in question.

What We Found:

To gauge the future status of oaks in Iowa, we compared the number of oak saplings—live trees that are 1 to 5 inches in d.b.h.—with other common forest species. Iowa's woodlots contain substantially fewer oak saplings than saplings of other species (fig. 1.25). On a per acre basis, oaks also have far fewer saplings than other forest species (fig. 1.26).

What This Means:

The low rate of oak regeneration as expressed by the number of saplings is perplexing to forest managers because there is no single cause of poor regeneration, which is the result of the cumulative impact of human actions and the biological consequences of those actions. For instance, recurrent fire is important for oak regeneration because it eliminates many of the oak's competitors. However, fire suppression has resulted in non-oaks taking over oak stands. Over the years, it has proven difficult to convince family forest owners of the value of cultivating and managing for oak. If oaks are to remain a viable component of Iowa's forests, active woodlot management to promote oak regeneration must be increased.

Figure 1.25. Number of saplings by selected species, Iowa, 1999-2003.

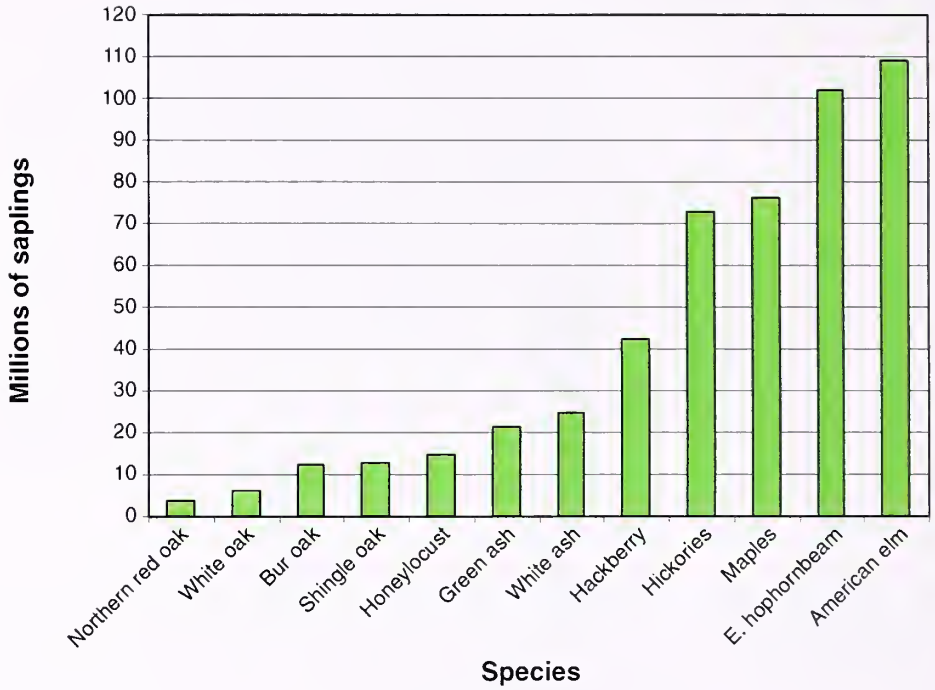
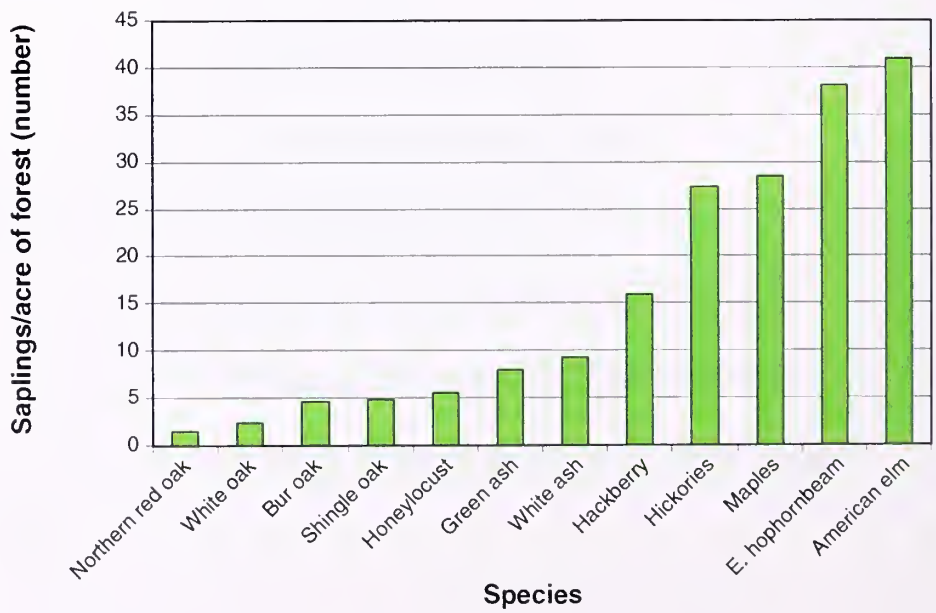


Figure 1.26. Average number of saplings per acre of forest land, by selected species, Iowa, 1999-2003.



Whose Woods Are These? Family Forest Owners

Background:

Iowa's family forest land owners are stewards of an important resource that provides both personal and societal benefits. As stewards, landowners maintain their woodlots to protect and enhance their personal interest while providing environmental and other benefits to the public. An owner's relationship with forests has important implications for resource sustainability, including the sustainable production of timber and the continued flow of goods and services.

What We Found:



Photo courtesy of USDA Natural Resources Conservation Service

We used data from the National Woodland Owners Survey to describe Iowa's family forest owners (Butler and Leatherberry 2004, 2005). An estimated 138,000 family forest owners in Iowa hold nearly 82 percent of the forest area in the State (fig. 1.27). The number of family forest owners increased dramatically over the last decade as nearly half acquired land during that time (fig. 1.28). As the number of owners increased, the average size of forest holdings decreased from 31 acres in 1993 (Birch 1996) to 12 acres in 2003 (fig. 1.29). Family forest owners tend to be older than the general population: 65 percent are age 55 or older and 6 percent are age 75 or older (fig. 1.30). People own forests primarily for privacy and aesthetic enjoyment (fig. 1.31). Many family forests owners are concerned that others may infringe on their land—trespassing and illegal dumping are paramount concerns. They also tend to be concerned about possible future harm that insects, disease, and nonnative plants could cause. Despite these concerns, only 1 percent of owners have a written forestry management plan and these people hold only 5 percent (87,000 acres) of family forest land. Twenty-nine percent of family forest owners have harvested timber from their woodlots, but only 8 percent have harvested saw logs. Most owners that harvested wood used it as firewood.

What This Means:

The increase in owners, many seeking the privacy and aesthetic enjoyment afforded by trees, has led to forests being broken into ever smaller tracts. In the coming years, more woodlots likely will be sold or change owners because more than one-third of family forest owners are 65 years old or older and they own 43 percent of family forests. Current ownership trends point to most new owners being "hobby" farmers or absentee owners. Harvesting timber from woodlots likely will decline because timber production is not an important reason for owning forests. Also closing family-owned forests to public use likely will increase, shutting off traditional uses such as hunting.

Figure 1.27. Distribution of forest area by type of owner, Iowa, 2003.

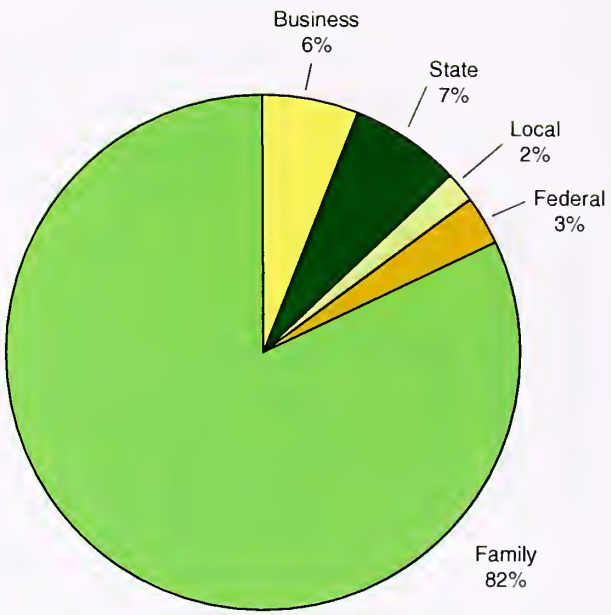


Figure 1.28. Distribution of family forest owner and acres tenure, Iowa, 2003.

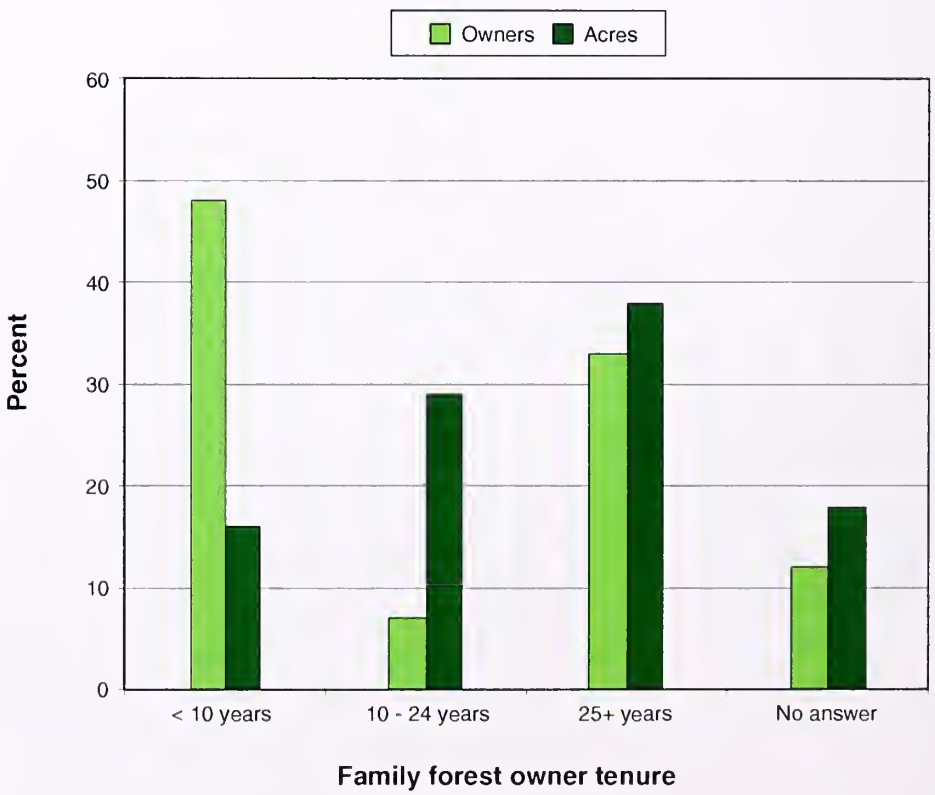


Figure 1.29. Distribution of family forest owners by size of holding, Iowa, 1993 and 2003.

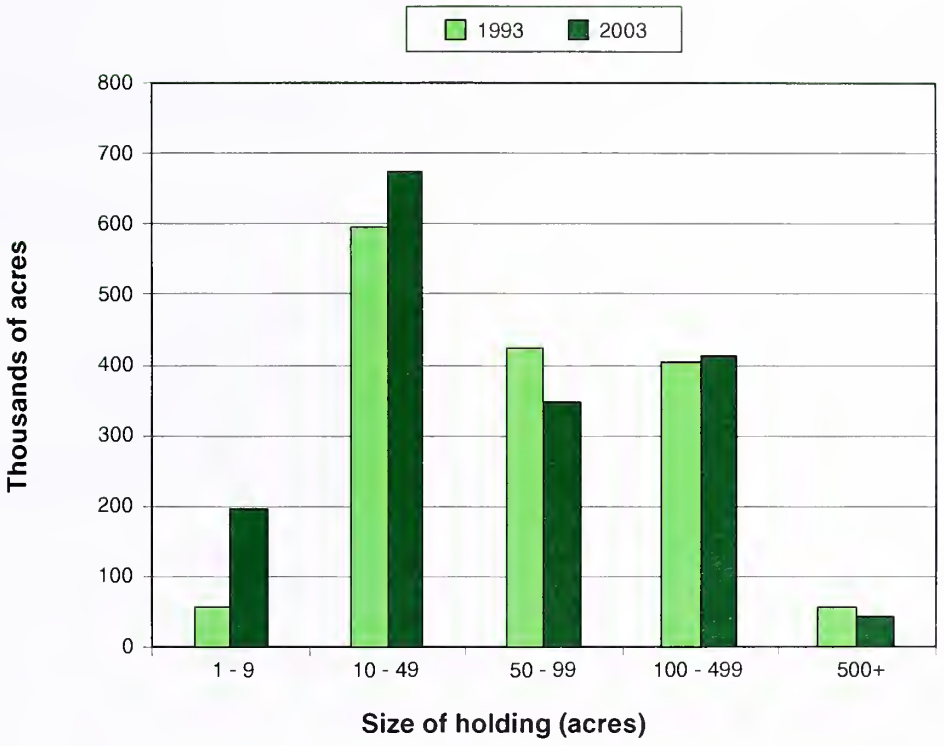


Figure 1.30. Distribution of family forest by owner and acreage by age, Iowa, 2003.

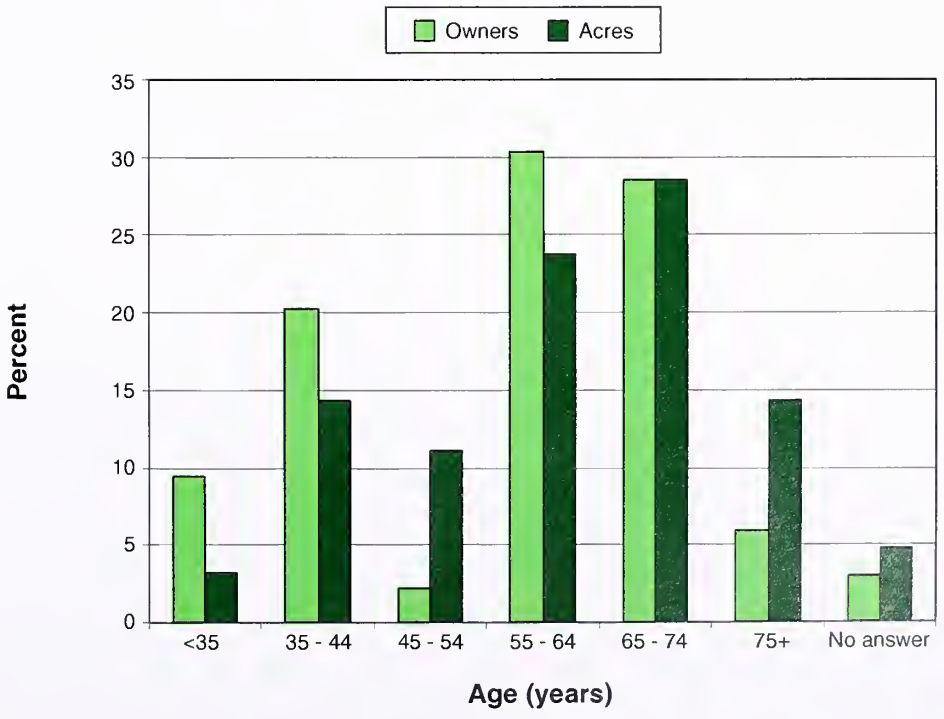
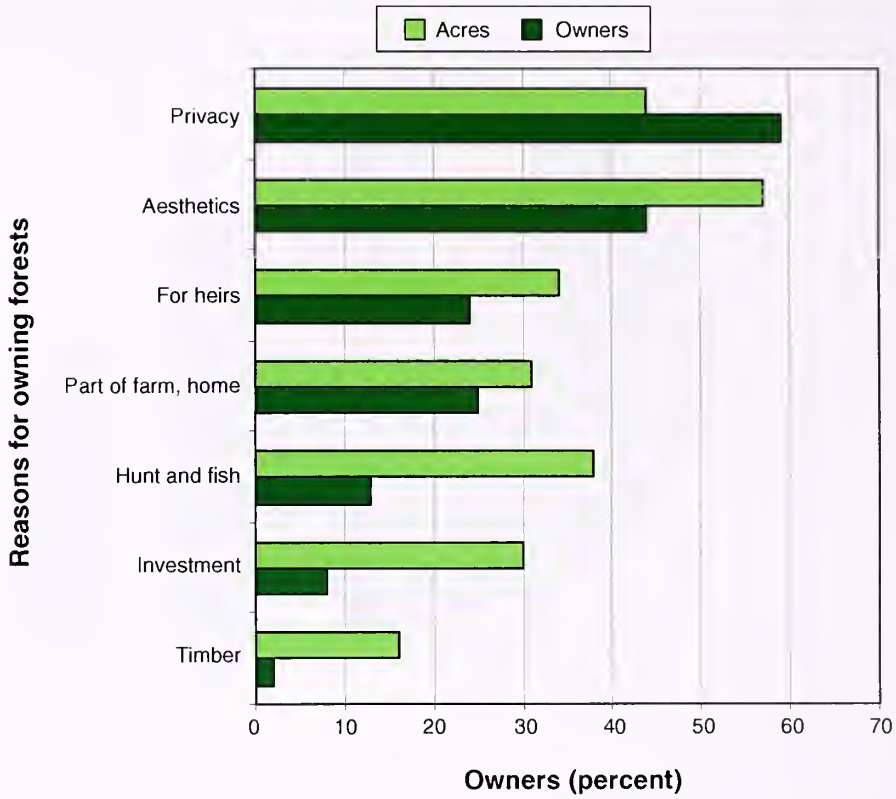


Figure 1.31. Distribution of family forest owners and acreage by reasons for owning forests, Iowa, 2003.



Whose Woods Are These? Public Forests

Background:

Public forests are a critical part of Iowa's natural resource wealth. They provide access to outdoor education and recreational opportunities, managed wildlife habitat, and protect special and unique areas. Public forests under special access rules are an indicator of Iowa's awareness of and commitment to the value of forests to future generations.

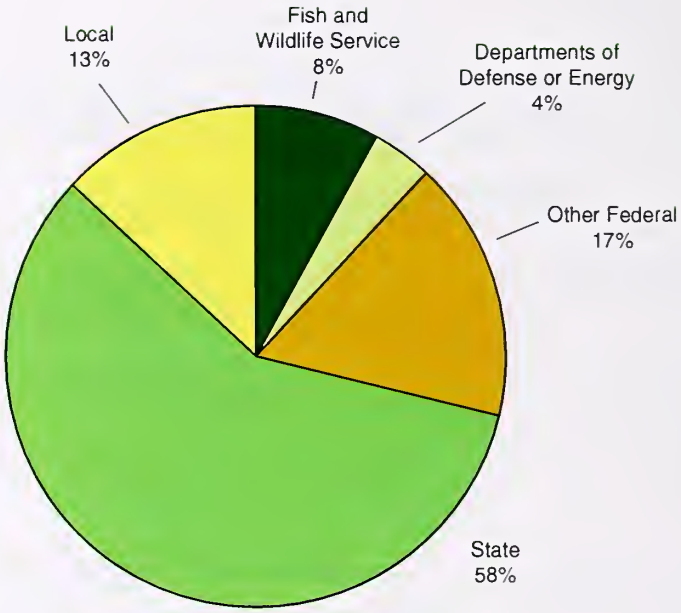
What We Found:

About 12 percent (309,000 acres) of forests in Iowa are publicly owned and scattered throughout the State. State government, principally the Iowa Department of Natural Resources, owns 6 of every 10 acres that are publicly held, followed by the Federal Government (3 of every 10 acres), and county and municipal governments holding nearly 1 of every 10 acres (fig. 1.32). Nearly 40,000 acres of public forests are reserved.

What This Means:

Most public forests are in state forests and parks. Stephens State Forest in the Southeastern unit is the largest with nearly 14,000 acres in seven units. The newest state forest, the 11,000-acre Loess Hills Forest in the Southwestern unit, is unique because of the windblown loess soils and varied plant life. These and other state forests—Shimek, Yellow River, and several smaller units—preserve larger blocks of forests and educate people about their value and uses. Many of Iowa's 83 state parks and recreation areas are places where people go to enjoy nature and an outdoor experience. Among federally owned forests, the USDI Fish and Wildlife Service and the U.S. Army Corps of Engineers are principal owners, overseeing wildlife refuges and flood control and navigational systems with accompanying recreation areas. Most of the reserved forests (28,000 acres) are owned by State agencies. These are areas where natural processes occur without interference from humans.

Figure 1.32. Distribution of public forest ownership, Iowa, 2003.





Forest Health

Insects and Diseases

Background:

Insects and diseases often cause damage when forests are affected by stressors such as drought and storm damage. Forest trees growing on poorer sites are particularly vulnerable. Monitoring of and responding to insect and disease outbreaks are important in maintaining healthy and vigorous forests.

What We Found:



Joseph O'Brien, USDA Forest Service, www.forestryimages.org

Several forest insects and diseases have been identified that adversely affect the health of Iowa's forests. Among these are Dutch elm disease, white oak decline, and general tree decline and dieback. Dutch elm disease, caused by the fungus *Ophiostoma umli/novo-umli*, occurs in every county. The gypsy moth (*Lymantria dispar*), which defoliates trees and is approaching from the East, is being monitored. In 2003, more than 3,500 field traps yielded 159 moths, an insufficient number to be considered a viable breeding population. White oak decline, a complex of insects and diseases that kills mature trees, is concentrated in northeastern Iowa (fig. 2.1). Oak wilt infection also damages trees, particularly in southeastern Iowa (fig 2.2). Caused by the fungus *Ceratocystis fagacearum*, oak wilt invades the water-conducting tissues (xylem) of oak trees. The foliage then wilts and dies. This disease is spread via root grafts and sap-feeding nitidulid beetles. General tree decline or dieback damages certain forest stands. Scattered dieback/decline occurs in native white and green ash in about one-third of Iowa's counties, mostly in central and eastern Iowa. The cause of ash dieback/decline is unknown. In 2003, drought conditions over much of the State affected trees, particularly in southwestern Iowa where extensive areas of oak are stressed. Forty-seven percent of Iowa's family forest owners consider insects or diseases an important threat to the overall health of forests.

What This Means:

Damage from insects and diseases remains largely localized, though the supply of oak for commercial use and wildlife habitat could decline. Forest management practices—control and containment—have been effective in combating insects and diseases. For example, early detection and eradication have prevented the establishment of viable breeding populations of the gypsy moth.

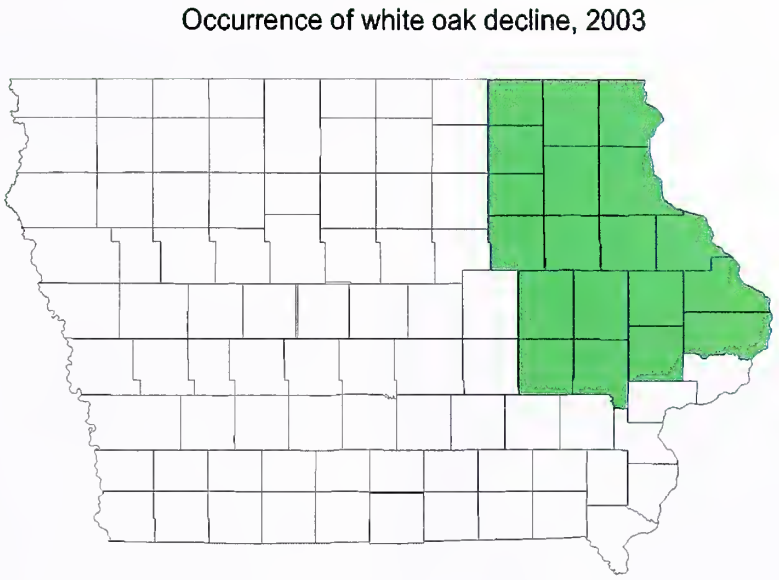


Figure 2.1. Shaded area indicates occurrence of white oak decline in Iowa, 2003. (Source: USDA Forest Service, Forest Health Highlights, 2003. Available online: http://fhm.fs.fed.us/fhh/fhh-03/ia/ia_03)

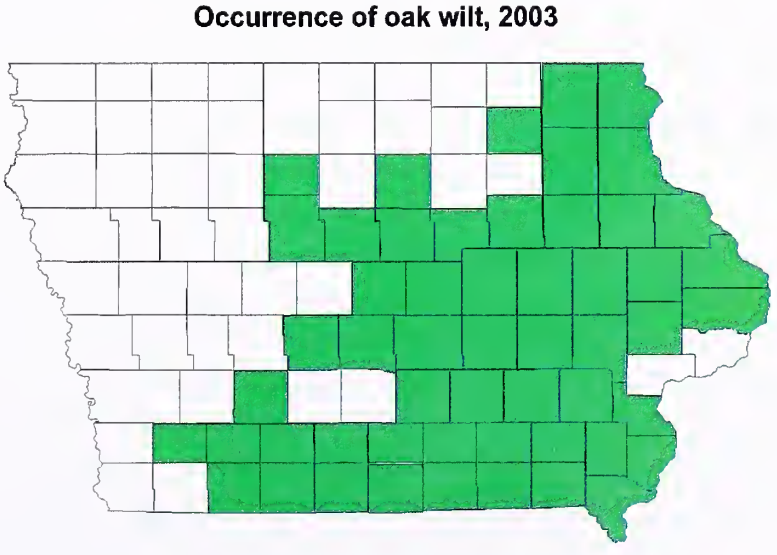


Figure 2.2. Shaded area indicates occurrence of oak wilt in Iowa in 2002. (Source: USDA Forest Service, Forest Health Highlights, 2002. Available online: http://fhm.fs.fed.us/fhh/fhh-02/ia/ia_02)

The Emerald Ash Borer: An Ominous Threat

Background:



David Cappaert, www.forestryimages.org

The emerald ash borer (*Agrilis planipennis*), native to East Asia, is a bark-burrowing insect that kills ash trees. In Iowa, white, green, and black ash trees are susceptible, as are several horticultural varieties. The adult beetles nibble on ash foliage but cause little damage. The larvae feed on the inner bark of ash trees, disrupting a tree's ability to transport water and nutrients. The emerald ash borer was first identified in the United States in the Detroit, Michigan, area and has spread to Ohio and Indiana. Although the borer is not known to be in Iowa, forest managers are concerned about the potential loss of ash from borer attacks.

What We Found:

The 60.9 million ash trees in Iowa's woodlots and along its streams and rivers account for an estimated 6 percent of forest trees in the State. Ash trees are found (at least one tree per acre of timberland) on 35 percent of the timberland area in Iowa. Ash is seldom dominant in most woodlots, but this species, particularly green ash, is common along rivers and streams in the western half of the State. Ash accounts for an estimated 3 percent of all live-tree volume and its use in the timber products industry is relatively limited. Ash contributes less than 3 percent of total statewide roundwood and saw log production. Between 1994 and 2000, ash saw log production in Iowa fell by 294,000 board feet[1], or nearly 12 percent.

What This Means:

If the emerald ash borer enters Iowa, about one-third of the State's forests would be affected. Ash mortality would be widespread and would severely affect lowland forests as it accounts for a large portion of lowland trees. In woodlots, mortality would be less noticeable because tree species other than ash dominate most of Iowa's woodlots. Mortality in urban areas would be more obvious and result in adverse economic impacts because ash is used widely as a shade and landscaping tree. The impact of the emerald ash borer on the State's timber products industry would be modest. Ash trees have not been used extensively by the industry and ash saw log production has declined in recent years. Although ash trees account for only 6 percent of forest trees, they occupy a unique ecological niche in Iowa's forests. The loss of ash trees would have a profound effect on forest ecosystem integrity, and possibly an irrevocable effect on forest species diversity. To monitor the threat of an emerald ash borer invasion, the Iowa Department of Natural Resources, Forestry Bureau, and several Federal and State agencies have implemented early detection programs.

[1]A board foot is 1 foot long, 1 foot wide, and 1 inch thick.

Forest Invaders: Nonnative Plant Species

Background:

Nonnative plants can overtake native woodland plants, threatening ecological diversity and increasing forest management costs through their impact on forest tree regeneration and growth. The Iowa Department of Natural Resources has identified four species—buckthorn, honeysuckle, garlic mustard, and multiflora rose—as nonnative plants that are adversely affecting the State's forests.

What We Found:



Paul Wray, Iowa State University, www.forestryimages.org

In 2002, we began collecting data on nonnative woodland plant species from 26 ground vegetation plots, a subset of forest inventory plots. The most prevalent nonnative species was multiflora rose (*Rosa multiflora*), which was found on more than one-third of sample plots (fig. 2.3). Common burdock (*Arctium minus*), was the second most common nonnative species. Several nonnative tree species were introduced by early settlers to make life easier on the prairie. The most common of these in Iowa, Siberian elm and Russian olive, were planted as shade trees in yards and around buildings. They also were used extensively for windbreaks, shelterbelts, and livestock protection, and to control soil erosion. There are an estimated 2.4 million Siberian elm and 173,000 Russian olive trees in forest stands in Iowa. An estimated 46 percent of family forest owners, holding 46 percent of family-owned forests in Iowa, consider "undesirable plants" as an important forest health concern.

What This Means:

Nonnative plant species are an emerging forest health concern in Iowa because they compete with native plant species for resources and threaten ecological diversity by altering natural plant communities. Nonnative plants pose an economic threat by lowering land values for agriculture, forestry, and recreation. In western and central Iowa, Siberian elm and Russian olive are problematical because they are moving from windbreaks, shelterbelts, and other protective plantings and invading formerly cultivated areas or forest edges. Both species are fast growing, hardy, and adaptable to most sites, often forming a dense shrub layer that displaces native species.

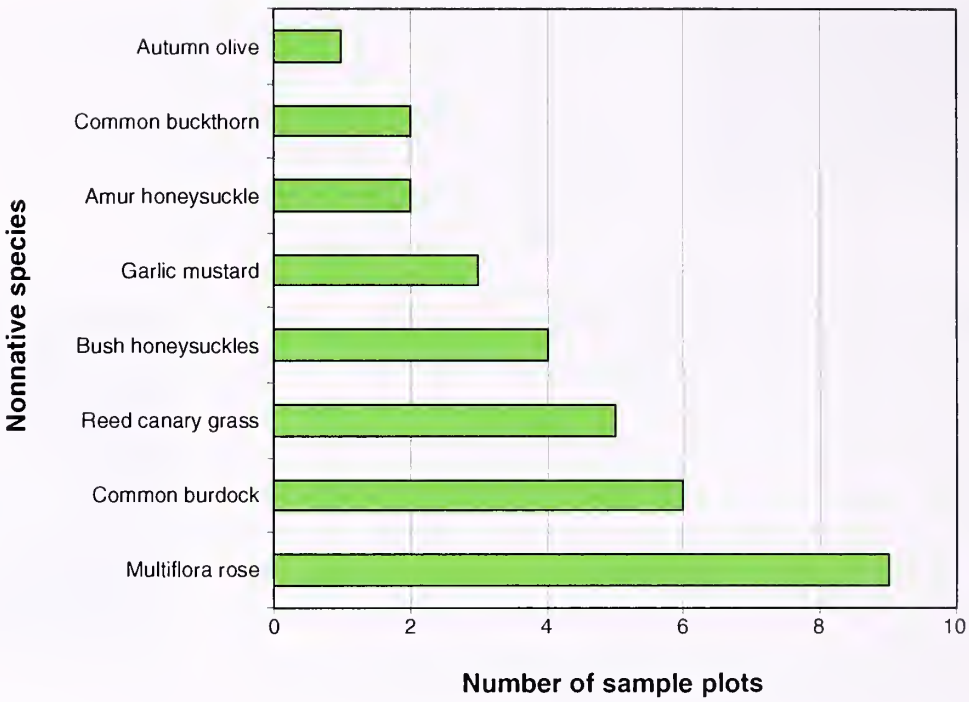


Figure 2.3. Occurrence of invasive plant species on vegetative diversity plots (n = 26), Iowa, 2001-2003.

Undesirable Forest Disturbances

Background:

Undesirable disturbances in forest stands can alter or degrade forest health. We recognize an area as disturbed when at least 1 acre of forest is affected by any type of naturally occurring event or human activity that occurred within the last 5 years and observable damage occurred to 25 percent of the individual trees in the stand. Observable damages do not include silvicultural activities or other intended changes to forests.

What We Found:

The 1999-2003 inventory revealed three primary causes of disturbances: livestock, weather, and wild animals. Disturbance caused by livestock occurred on an estimated 390,300 acres, or 15 percent of total forest area. Weather-caused damages occurred on an estimated 197,100 acres (7 percent). Although severe weather such as ice storms, wet heavy snow, and strong winds are common occurrences, major regional-scale weather events such as the widespread floods of 1993 can severely affect Iowa's forests (fig. 2.4). Ninety-four percent of weather-induced damage was from flooding. Floods increase stress on trees, particularly root systems, eventually killing them.

What This Means:

Most disturbances in Iowa's forests and woodlots are caused by livestock, primarily through grazing. The State's farmers have a long history of pasturing livestock in woodlots. Trampling and soil compaction slows tree growth, exposes tree roots, and impedes regeneration of native tree species. Overbrowsing by wildlife, particularly white-tailed deer, induces stress in trees. Much of the weather-caused disturbances occurred in the elm/ash/cottonwood forest type group, which consists of species such as cottonwood, hackberry, willow, and green ash that grow best in moist, low-lying areas, e.g., floodplains. Trees in these areas were in water for an extended period during the floods of 1993. Many trees that were stressed became increasingly susceptible to secondary insect and disease attacks.

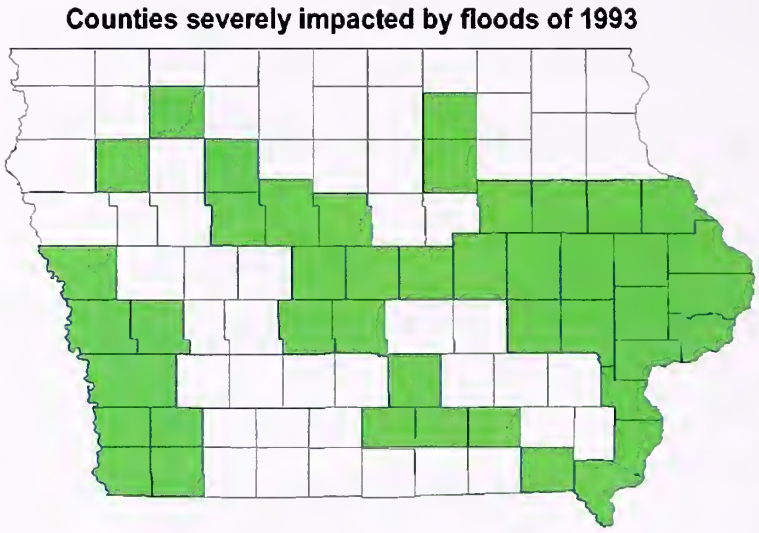


Figure 2.4. Shaded areas represent counties severely impacted by the floods of 1993. (Source: USDA Forest Service, Forest Health Highlights, 1995. Available online: http://fhm.fs.fed.us/fhh/fhh-95/ia_95)

Down Woody Debris—Is There A Fire Danger?

Background:

Down woody debris in the form of fallen trees, branches, litter fall, and duff plays a critical role in Iowa's forests. Such debris largely determines forest fire behavior, provides valuable wildlife habitat, and is an important carbon stock.

What We Found:

The fuel loadings of down woody materials (fuel-hour classes) are not exceedingly high in Iowa (fig. 2.5). Compared with neighboring Missouri and Illinois, Iowa's loadings of 100- and 1,000+-hr fuels are not significantly different, but the loadings of the smallest fuels (1 and 10 hr) are significantly greater than in Illinois and Missouri. The small sample size (n = 21) should be noted for the down woody inventory in Iowa (hence the large standard errors). There was an apparent trend in total down woody fuel loadings (fine and coarse woody debris) among classes of live-tree density in the State (fig. 2.6). The size-class distribution of coarse woody debris is heavily skewed (88 percent) toward pieces less than 8 inches in diameter (fig. 2.7a). The decay-class distribution of coarse woody debris is dominated by moderate stages of decay across the State (fig. 2.7b). The spatial distribution of coarse woody debris volumes indicates that coarse woody debris volumes are highest in the Northeastern unit (fig. 2.8).

What This Means:

The fuel loadings in Iowa's forests are not a sizeable fire hazard except in local areas when fuel moistures are extremely low. Given the highly fragmented nature of Iowa's forests, coarse woody volumes are not substantially high in a contiguous pattern across the State. Iowa's coarse woody debris resource is dominated by small pieces. Overall, down woody materials do not pose a sizeable fire danger, and there is sufficient coarse woody debris to provide wildlife habitat for smaller fauna.

Figure 2.5. Estimates of mean fuel loadings (tons/acre) and associated standard errors by fuel-hour class for Illinois, Iowa, and Missouri.

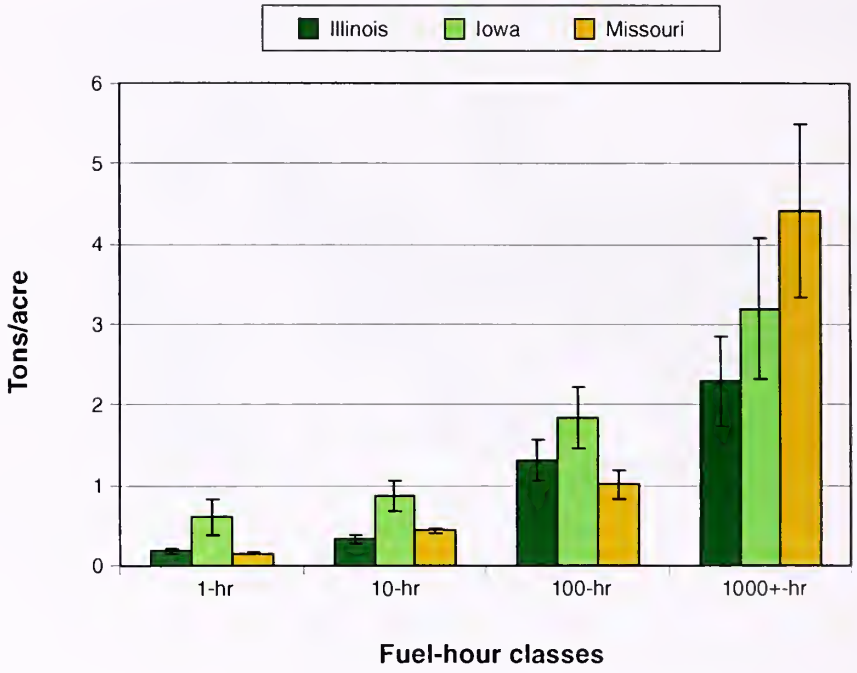


Figure 2.6. Estimates of mean down woody fuels (tons/acre, fine and coarse woody debris) and associated standard errors by stand density (basal area/acre), Iowa, 2001-2003.

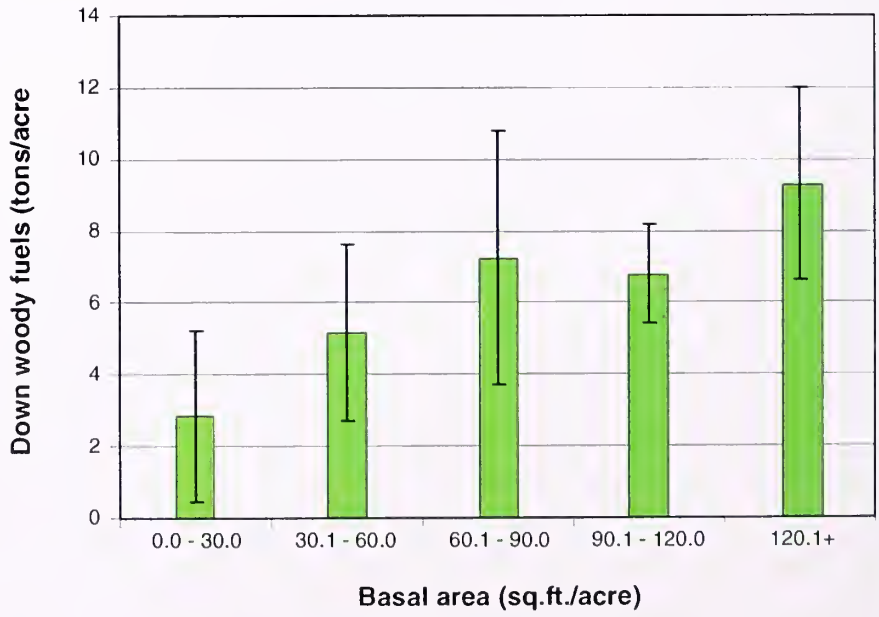
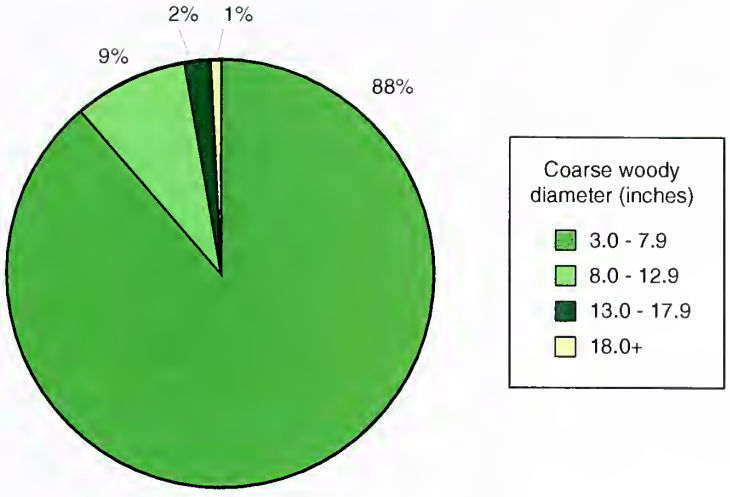
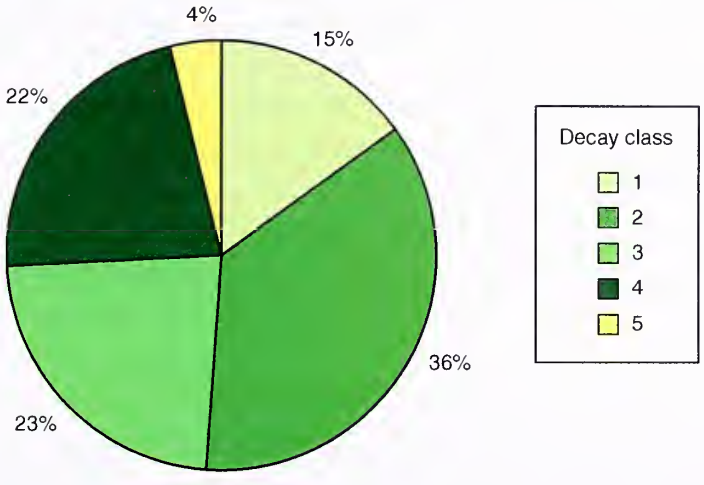


Figure 2.7a,b. Mean distribution of coarse woody debris (pieces per acre) by size class and decay class (1=least decayed...5=most decayed), Iowa, 2001-2003.

2.7a



2.7b



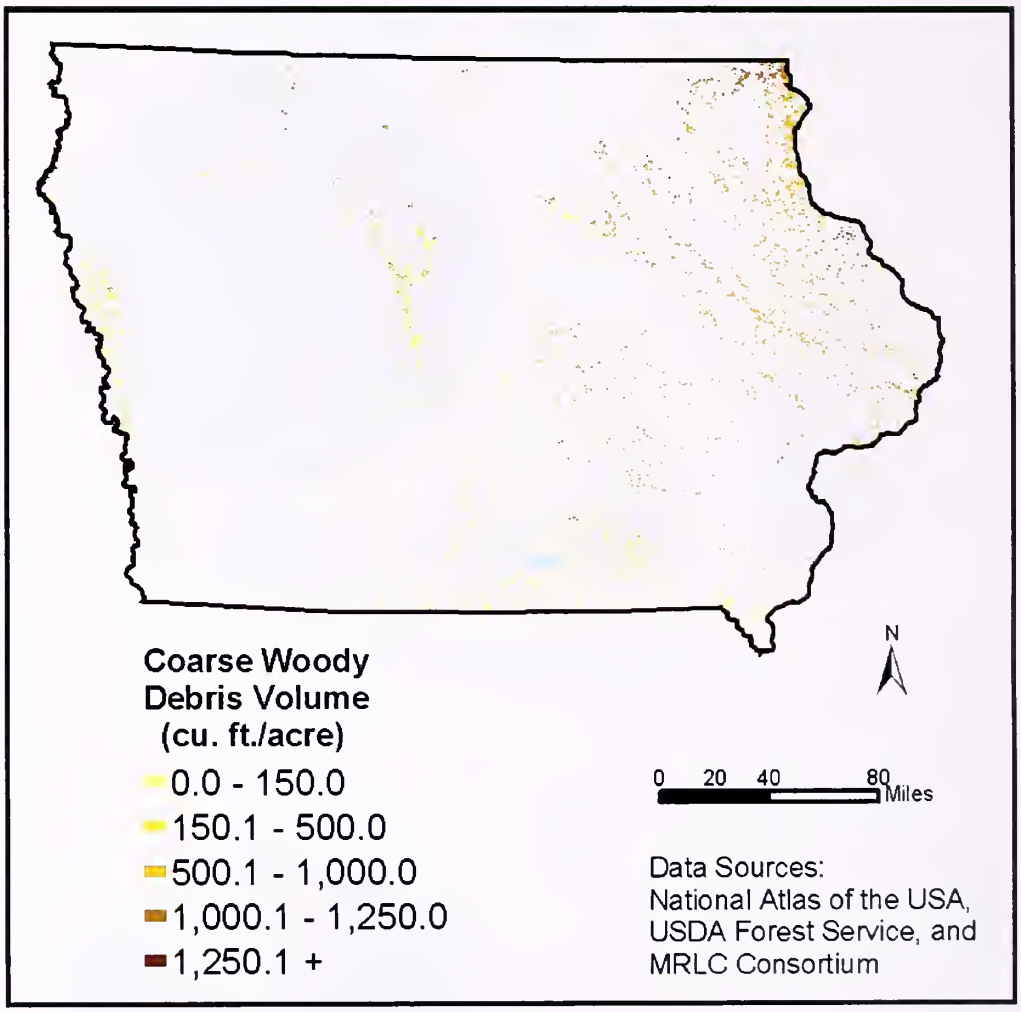


Figure 2.8. Interpolated map (inverse-distance weighting) of coarse woody debris volumes, Iowa, 2001-2003.

Ozone Damage

Background:

Bioindicator species in eastern Iowa and downwind of major urban areas are at moderate risk of ozone injury while forests in most of western and central Iowa are at low risk. Ozone exposures occasionally reached sufficient hourly concentrations and seasonal cumulative values to cause foliar injury on the more sensitive bioindicator species. However, it is difficult to assess these subtle effects because of other critical growth and health variables, e.g., drought, insects, diseases, competition, and invasive species.

What We Found:

Ozone bioindicator data were first collected in 2000 and the national ozone grid consisting of seven permanent biosites in Iowa was established in 2002. Species used most commonly were common milkweed, black cherry, blackberry, and white ash. Foliar injury was limited on bioindicator species from 2000 to 2002:

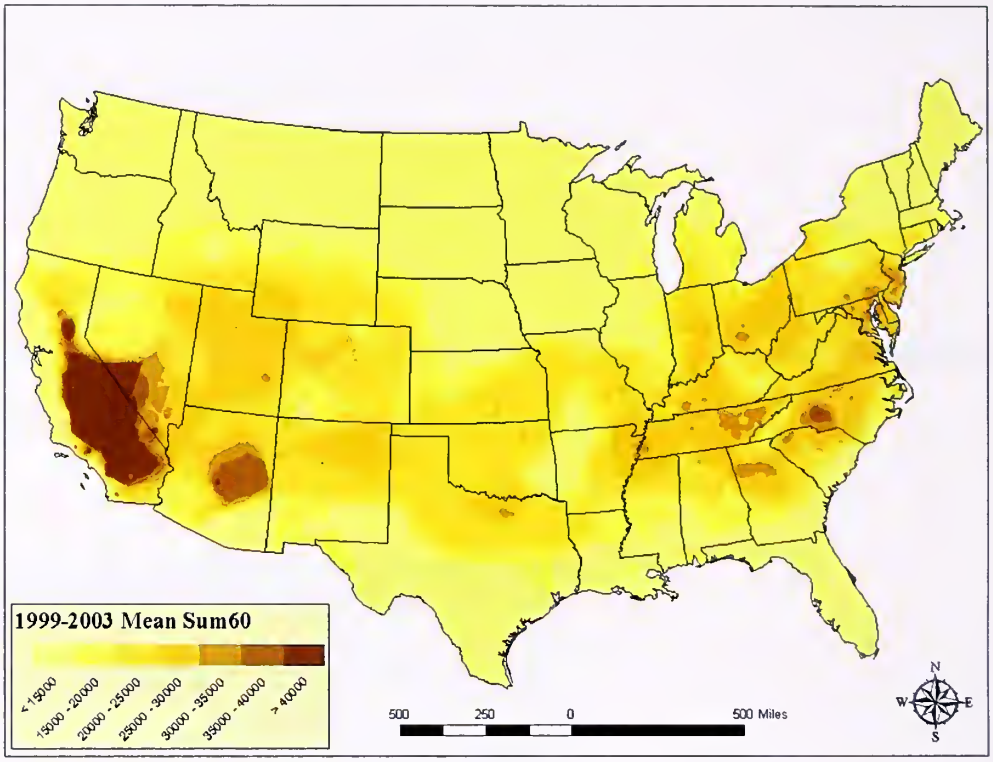
Parameter	2000	2001	2002
Number of biosites	8	8	7
Biosites with injury (%)	0	0	15
Number of plants evaluated	312	379	673
Number of plants with injury	0	0	1
Average number of species/biosite	1.9	2	3.5

Ground-level ozone exposures in Iowa are among the lowest of the North-central States and are modest compared to the serious pollution in the Chicago and St. Louis metropolitan areas (fig. 2.9). Seasonal cumulative exposures calculated from ozone monitoring stations indicate that significant portions of the State fall below critical exposure thresholds, resulting in significant foliar injury, growth loss, or other adverse long-term consequences.

What This Means:

Iowa's forests are exposed to peak hourly concentrations of ozone and seasonal cumulative concentrations above preindustrial levels. However, these exposures generally are not sufficient to result in observable or measurable adverse impacts. Consequently, the risk from ozone is considered low over most of the State. Ozone-sensitive species in eastern Iowa and downwind of major urban areas are at modest risk during summers with above-average ozone concentrations.

Figure 2.9. Average national ozone exposure, 1999-2003.



Soils

Background:

Rich soils are the foundation of productive forests. Inventory and assessment of the forest soil resource provides critical baseline information on forest health and productivity, particularly in light of continued natural and human disturbance.

What We Found:

The forests of Iowa are largely underlain by mollisols and alfilsols; entisols and vertisols also are present (fig. 2.10). Mollisols are identified by the presence of a mollic (dark and humus rich) surface horizon and high base saturation. Mollisols developed under Iowa's prairie landscape and now are some of the most productive croplands in the Nation. Alfisols are fertile soils generally possessing an illuvial clay horizon and a medium to high base saturation. Most alfisols developed under deciduous forest. Entisols are identified by the absence of pedogenic horizons; this may be the result of insufficient time for soil development or resistant parent material. In Iowa, these soils are most common along drainages. Vertisols are clay-rich soils that undergo dramatic shrink and swell cycles that churn the soil over time. They are identified by the layer greater than 25 cm (10 inches) thick that includes a slickenslides—polished and grooved surfaces and generally have dimensions exceeding 2 inches—within 40 inches of the surface clay content exceeding 30 percent, and cracks that open and close periodically. The forest floors under the elm/ash/cottonwood forest type group are thinner than those under other groups (fig. 2.11). At the same time, the elm/ash/cottonwood group occurs on soils with a higher coarse fragment content (fig. 2.12) and exchangeable sodium (fig. 2.13). The elm/ash/cottonwood group also has higher sulfur concentrations than the oak/hickory group (fig. 2.14). Soils under the maple/beech/birch group have higher phosphorus concentrations than those under the elm/ash/cottonwood group (fig. 2.15). Other chemical properties are similar across all forest-type groups. A soil quality index (SQI), which combines distinct physical and chemical soil properties, revealed that SQI values generally increase from east to west (fig. 2.16). Greater amounts of carbon are stored in soils that are 0 to 4 inches thick, while carbon averages generally increase from southeast to northwest (fig. 2.17). The Des Moines lobe soils have the highest averages for both SQI and soil carbon.

What This Means:

Trees associated with the elm/ash/cottonwood forest type group deposit litter that breaks down more quickly than that of many trees in other groups, and they do not accumulate the same amount of forest floor over time. The high coarse fragment content under the elm/ash/cottonwood group might result from stands primarily in riparian zones. Most of the phosphorus available to trees is from decomposing organic material. The thin forest floor and low phosphorus content of elm/ash/cottonwood forest soils indicate a potential nutrient deficiency. The potential for a phosphorus deficiency would have to be tested

against phosphorus requirements by the species in question. The causes and implications of the observed sodium and sulfur patterns require additional investigation.

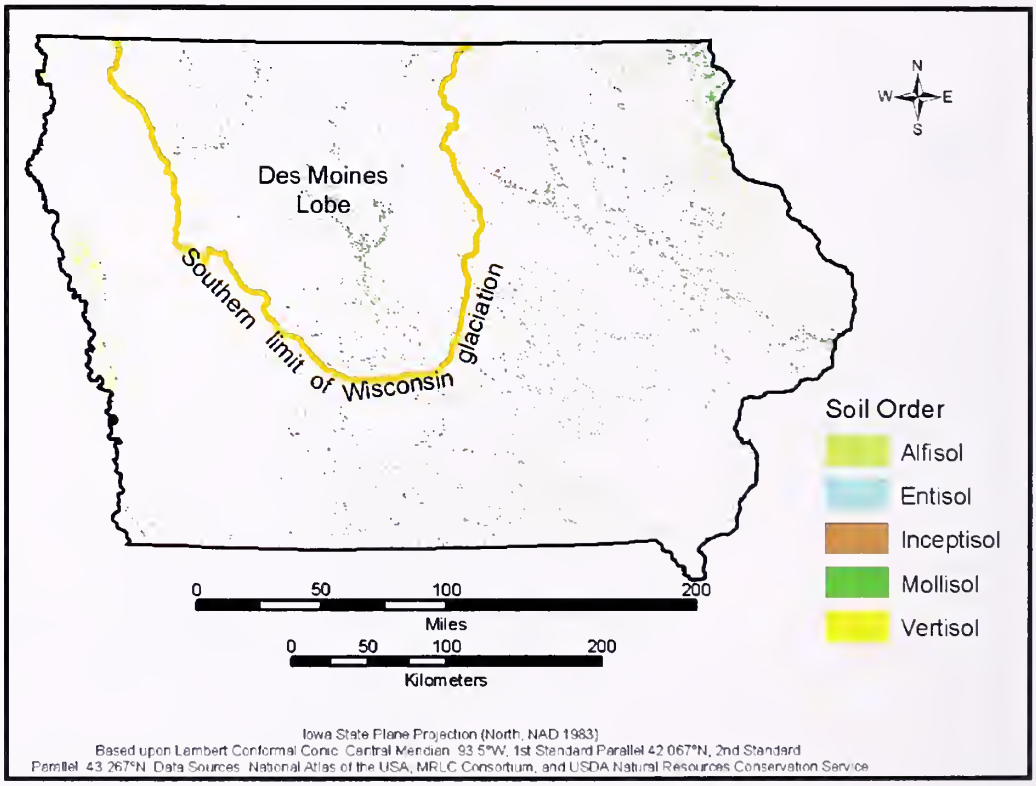


Figure 2.10. Southern limits of last glacial and present soil orders, Iowa.

Figure 2.11. Forest-floor thickness for selected forest type groups, Iowa, 2003 (data from 2001-2003; error bars represent 1 standard error).

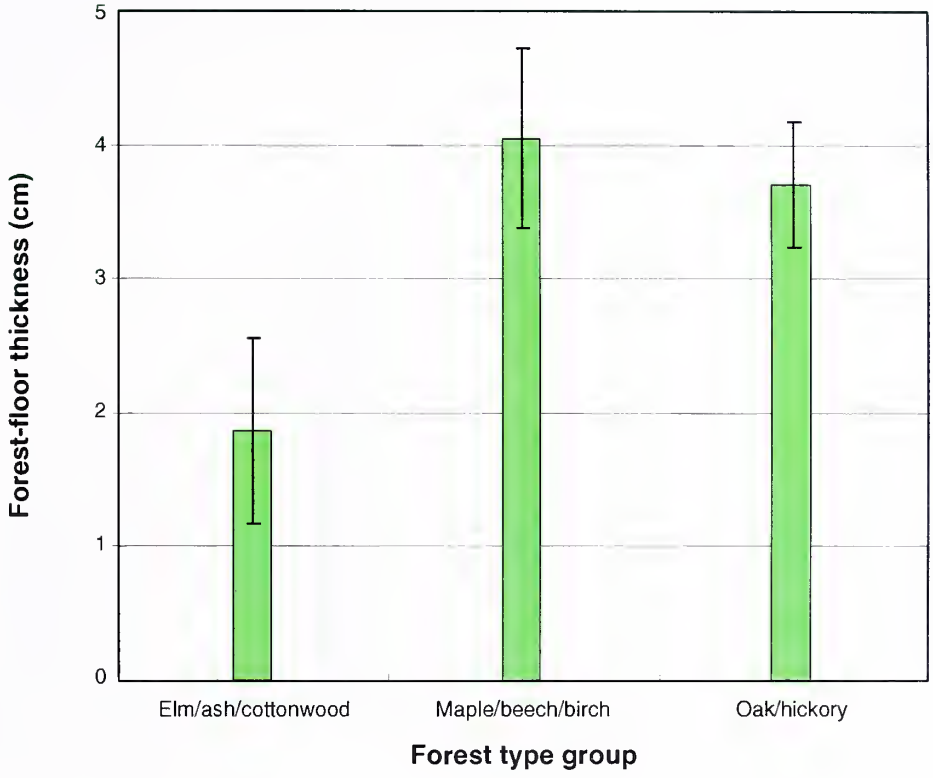
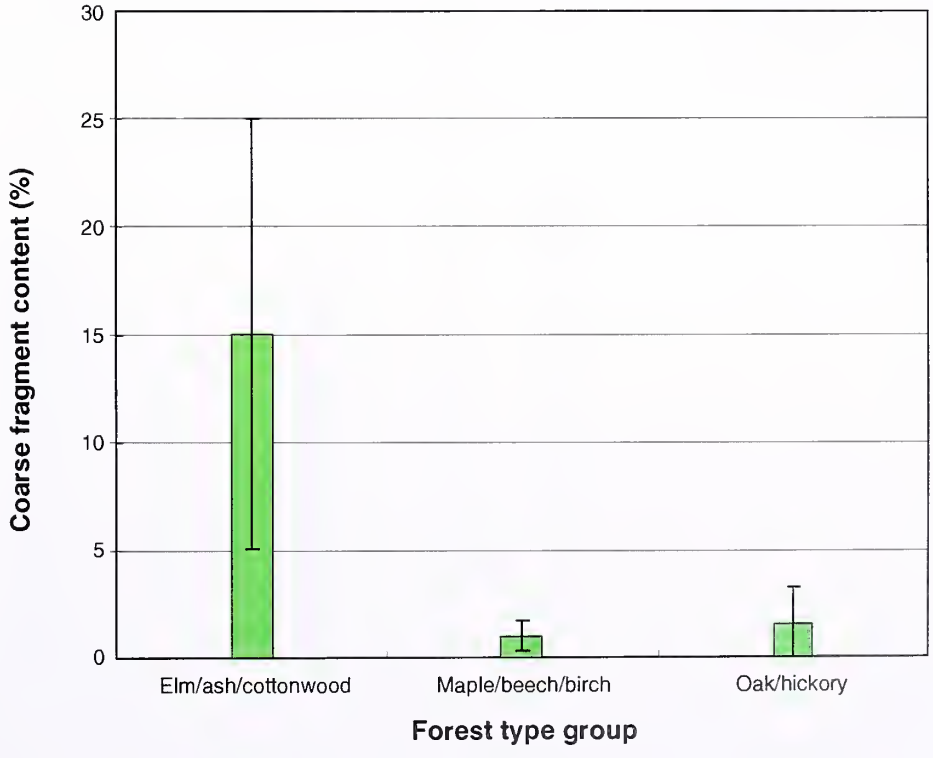


Figure 2.12. Coarse fragment content by selected forest type groups, Iowa, 2001-2003 (error bars represent 1 standard error; similar results were observed in the 10-20 cm samples).



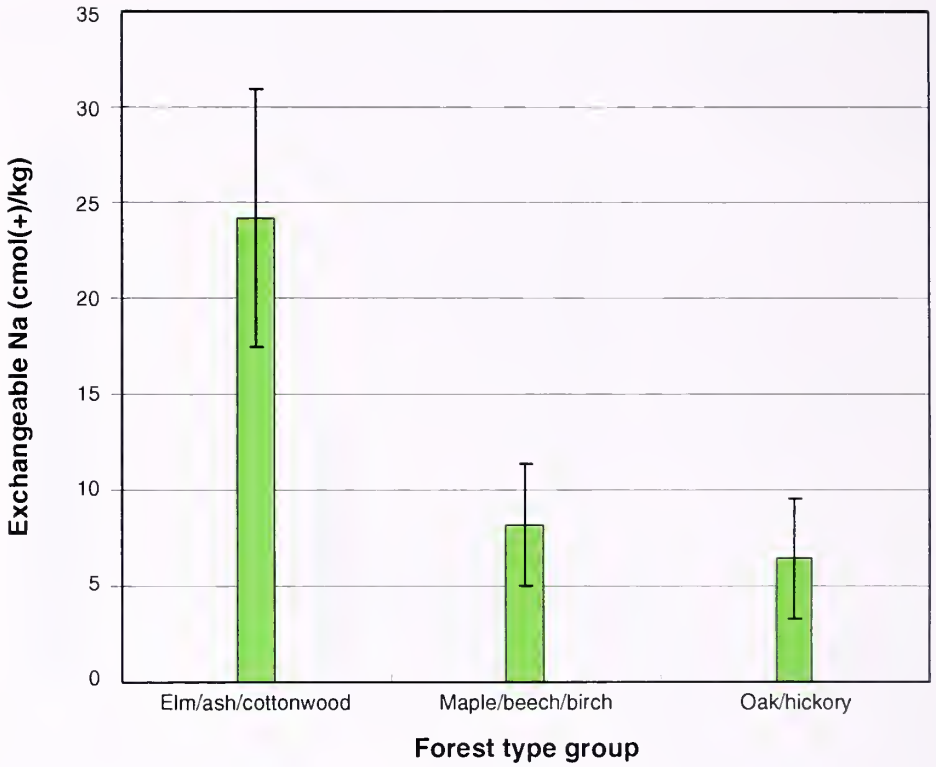


Figure 2.13. Exchangeable sodium for selected forest type groups, Iowa, 2001-2003 (data from 2001-2003; error bars represent 1 standard error).

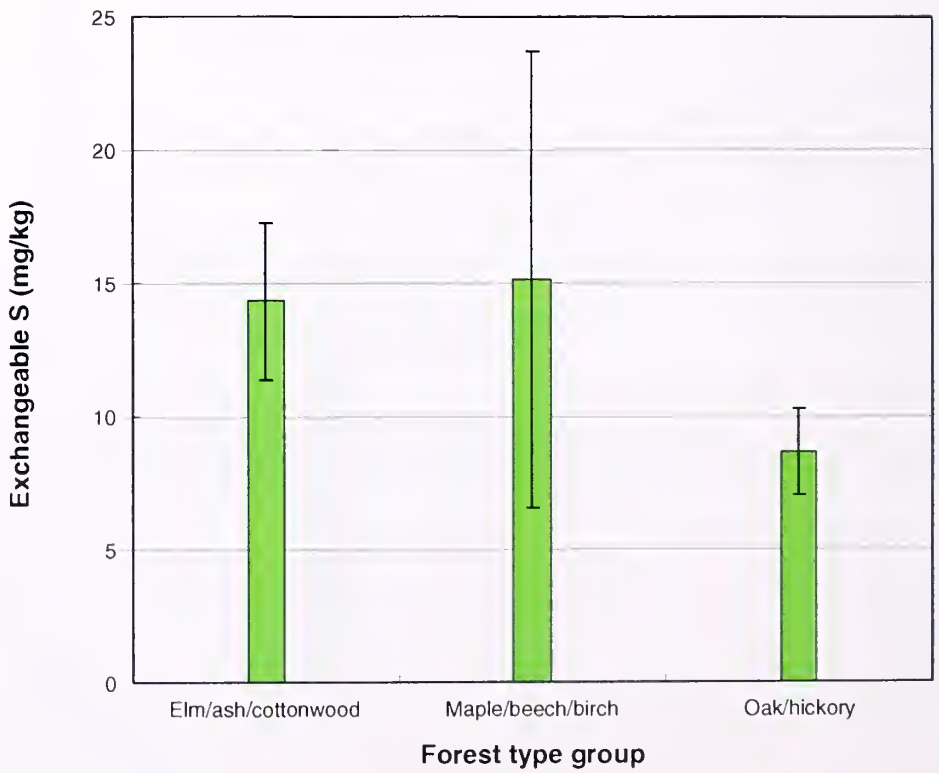


Figure 2.14. Exchangeable sulfur for select forest type groups, Iowa 2001-2003 (error bars represent 1 standard error).

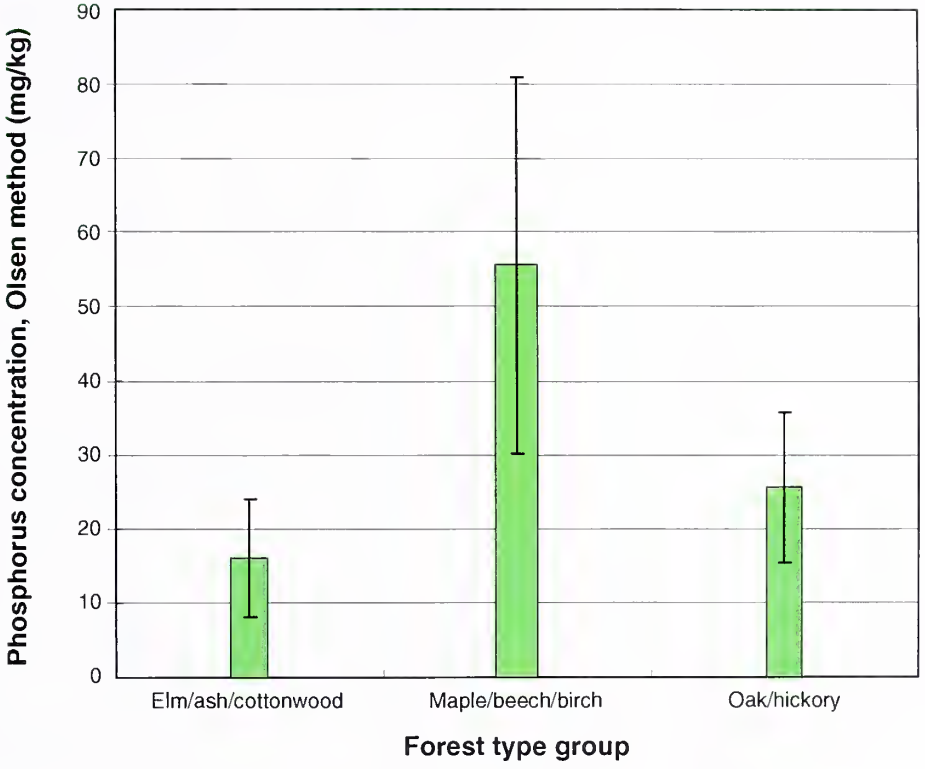
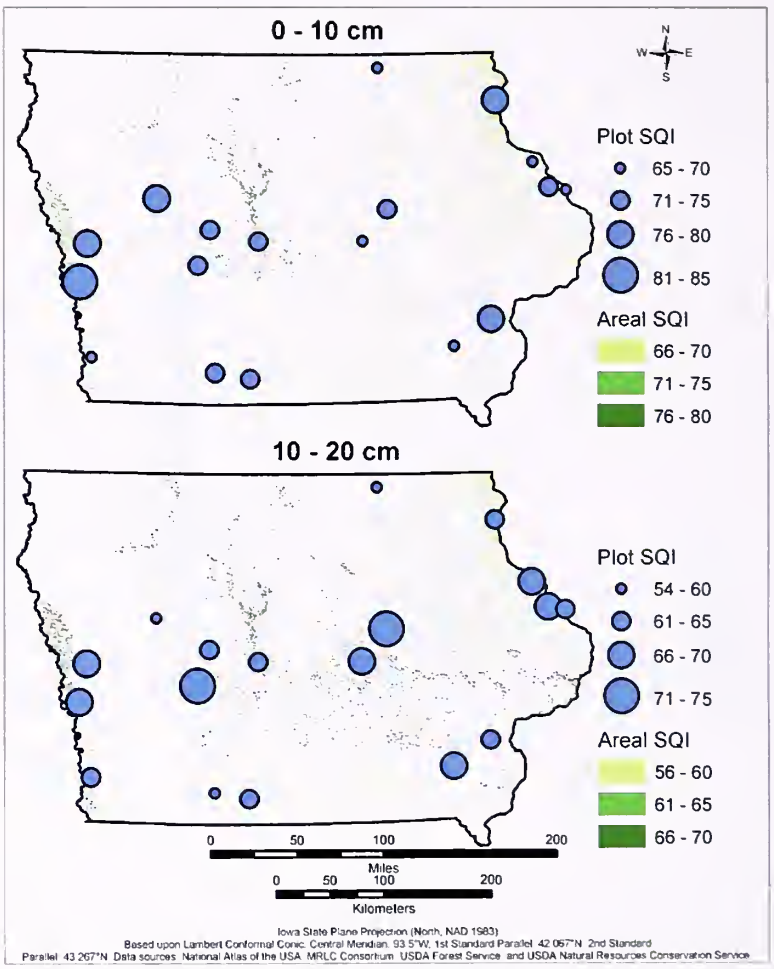


Figure 2.15. Phosphorus concentration for selected forest type groups, Iowa, 2001-2003 (error bars represent 1 standard error).

Figure 2.16. Soil quality index values for plots and averaged across Major Land Resource areas, Iowa, 2001-2003.



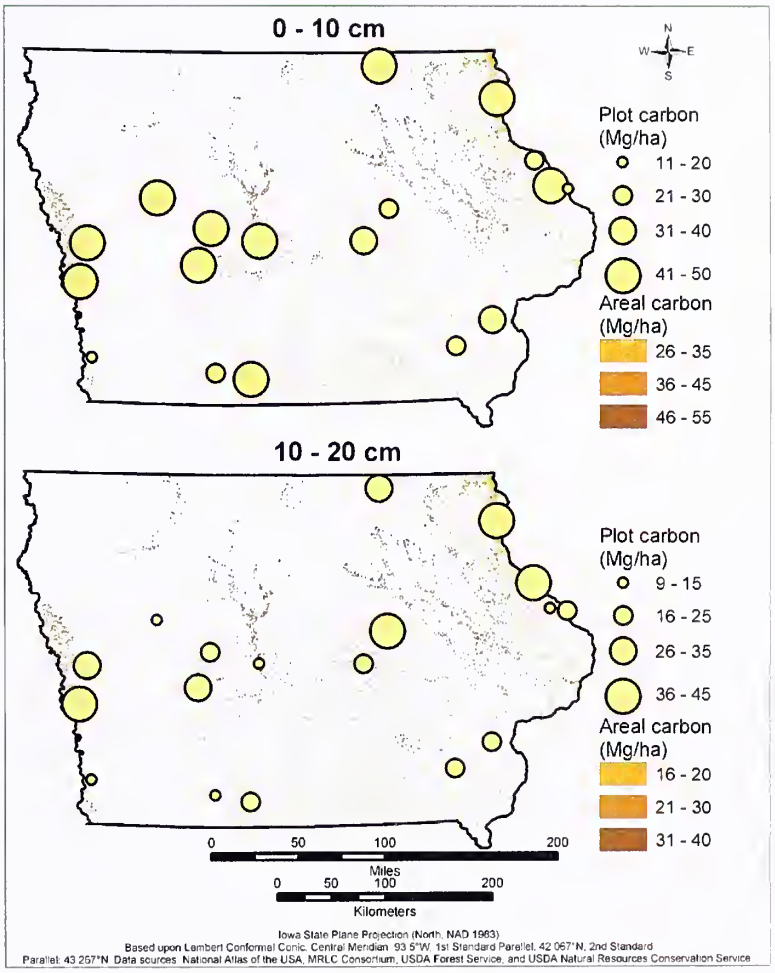
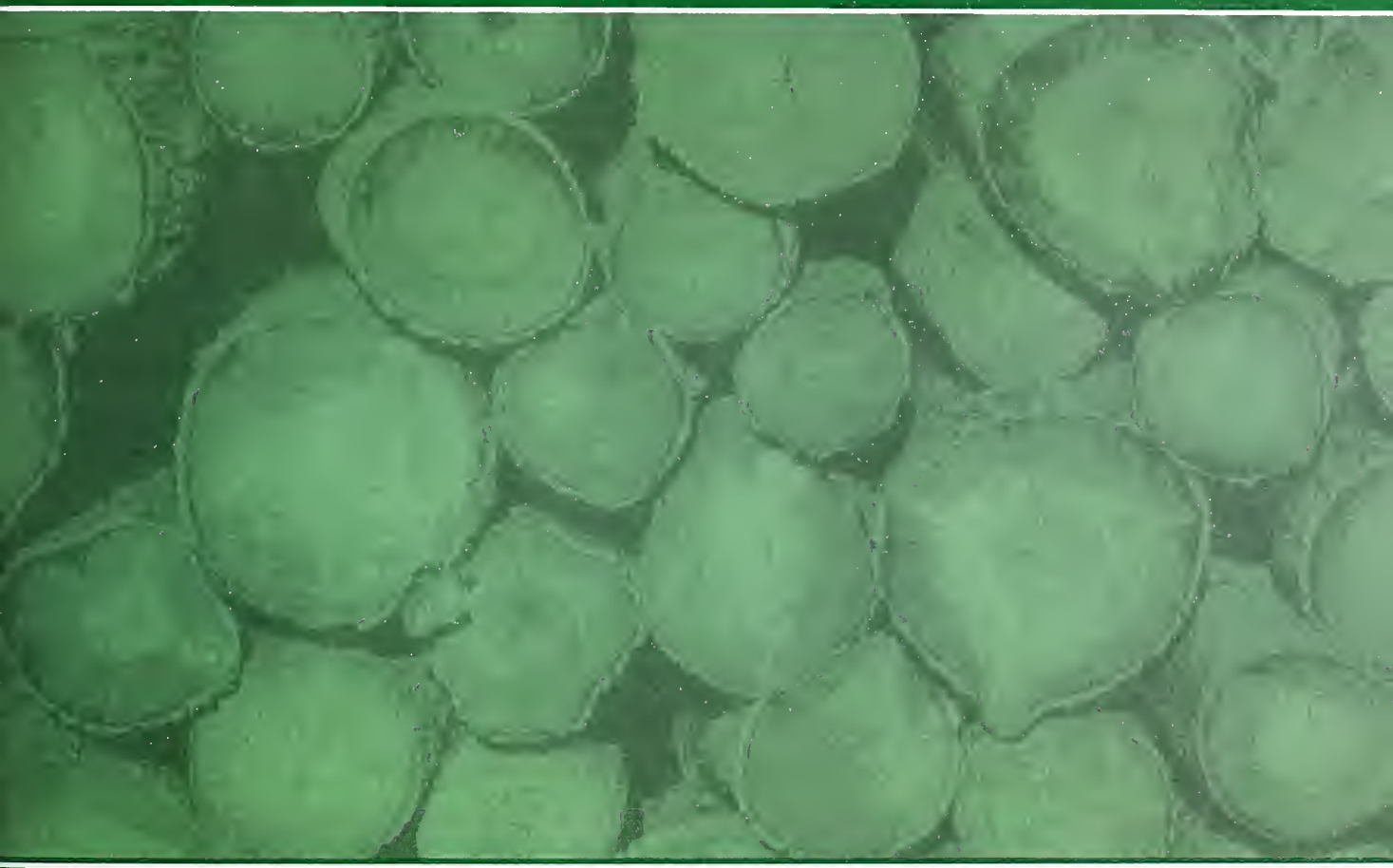


Figure 2.17. Soil carbon sequestration observed on plots and averaged across Major Land Resource areas, Iowa, 2001-2003.



Forest Products

Growing-Stock Volume

Background:

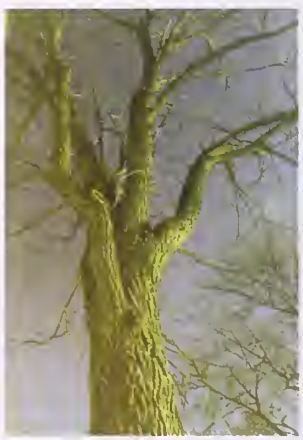
Growing-stock volume is a measure that has been used to estimate the amount of wood suitable for manufacturing products. Growing stock is wood volume in standing trees that are healthy, sound, reasonably straight, and more than 5 inches in d.b.h. Estimating live wood that is potentially available for manufacturing wood products is important in economic planning and development and is an essential consideration in evaluating sustainable forest management.

What We Found:

Growing-stock volume has increased steadily since 1974 and currently totals an estimated 2.9 billion ft^3 (fig. 3.1). Ten species account for 75 percent of all growing-stock volume in Iowa (fig. 3.2). Between 1990 and 2003, several of the 10 species increased substantially in growing-stock volume (fig. 3.2). Noteworthy was the increase in black walnut (198 percent), hackberry (137 percent), bur oak (118 percent), and eastern cottonwood (115 percent). Growing-stock volume currently averages 1,122 ft^3/acre of timberland, nearly twice the amount in 1954 (fig. 3.3). Increases in volume were substantial in all but the smallest diameter classes (fig. 3.4).

What This Means:

Much of the increase in growing-stock volume since the 1970s is due to the growth of larger trees, riparian forest restoration, and the reversion of pasture to timberland. Currently, Iowa's woodlots supply much of the wood for the State's timber products industry. However, the industry could be adversely affected by increasing mortality and changing species composition. Much of the oak volume is near maturity and at risk from age-induced mortality. The species composition of woodlots and riparian forests is changing; for example, the growth rate of silver maple exceeds that of commercially important species such as red and white oak.

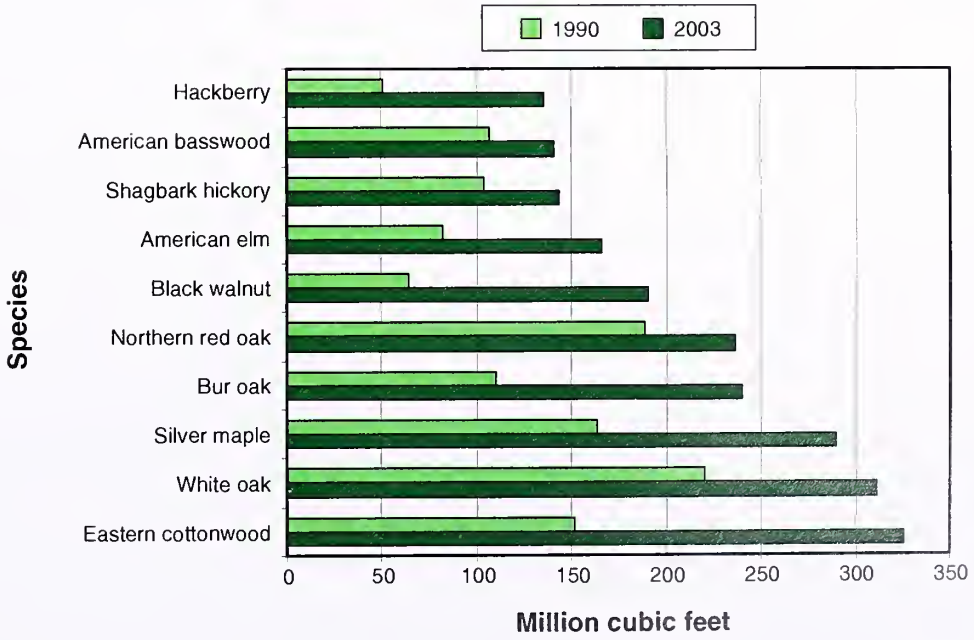


Bill Cook, Michigan State University, www.forestryimages.org

Figure 3.1. Total volume of growing stock on Iowa's timberland, 1954 through 1999-2003.



Figure 3.2. Net volume of selected hardwoods in Iowa for the 1990 and 1999-2003 inventories.



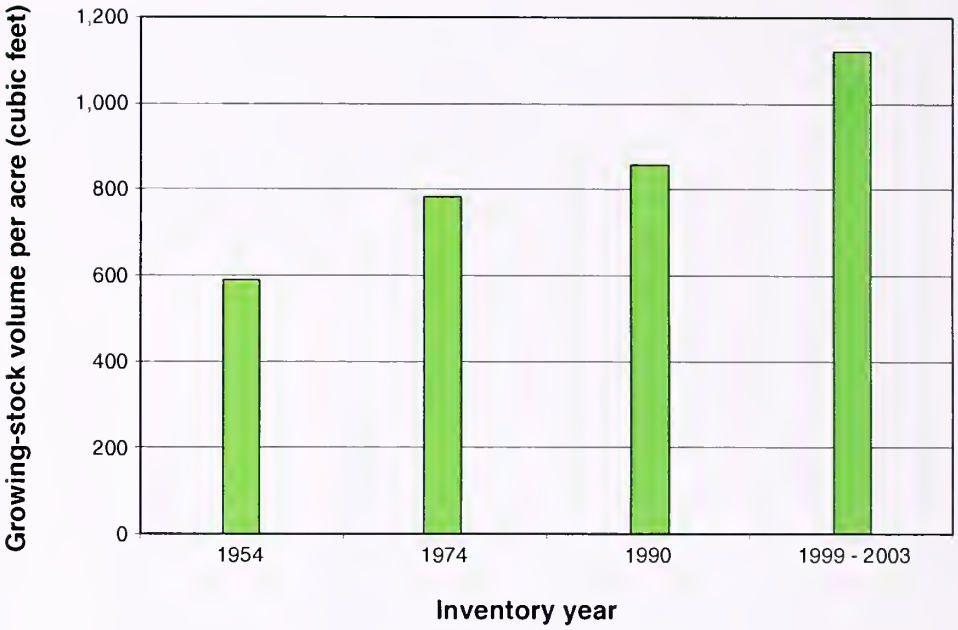


Figure 3.3. Average growing-stock volume per acre of timberland in Iowa, 1954 through 1999-2003.



Figure 3.4. Distribution of growing-stock volume by diameter class in Iowa for the 1990 and 1999-2003 inventories.

Sawtimber Volume

Background:

Sawtimber is the wood in the saw log portion of a tree (the section of a tree's bole between the stump and the saw-log top, measured in board feet). Live sawtimber volume is used to determine the monetary value of wood volume in a tree or how much usable product might be manufactured from that volume. When saw logs are sawn into pieces by sawmills, the pieces are converted to products such as lumber, veneer, and furniture stock.

What We Found:

Sawtimber volume declined between the 1954 and 1974 inventories but then rebounded in the 1980s and increased steadily to 10.5 billion board feet in 2003 (fig. 3.5). Between 1990 and 2003, average sawtimber volume per acre of timberland increased substantially, from 2,979 to 4,072 board feet. Virtually all sawtimber volume is in hardwoods (fig. 3.6). Since the 1990 inventory, most commercial species increased in total sawtimber volume, with black walnut, bur oak, and eastern cottonwood increasing by more than 100 percent (fig. 3.7). As a percentage of total sawtimber volume, black walnut volume increased from 4 percent in 1990 to 7 percent in 2003.

What This Means:

Sawtimber volume increased substantially between 1990 and 2003, with black walnut showing the largest percent change in volume. This reflects the commercial importance of this species. Many woodland owners actively manage black walnut to maximize its stumpage value. In northern red oak and white oak, sawtimber volume increased modestly compared to most other species. This reflects both high demand for oak saw logs and oak regeneration failures.

Figure 3.5. Total sawtimber volume on Iowa's timberland, 1954 through 1999-2003.



Figure 3.6. Percentage of total sawtimber volume on timberland in Iowa for selected species, 1999-2003.

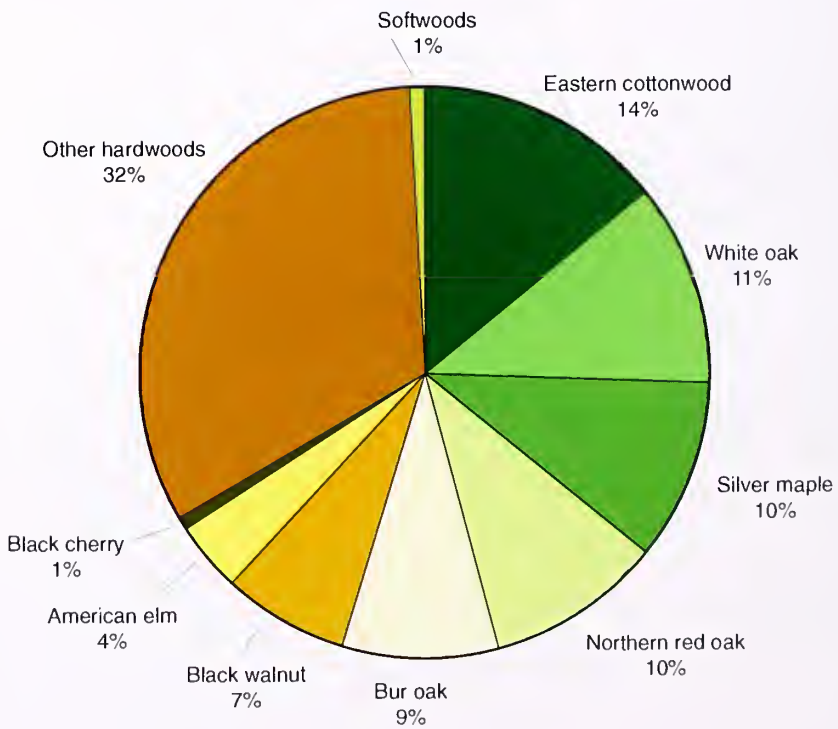
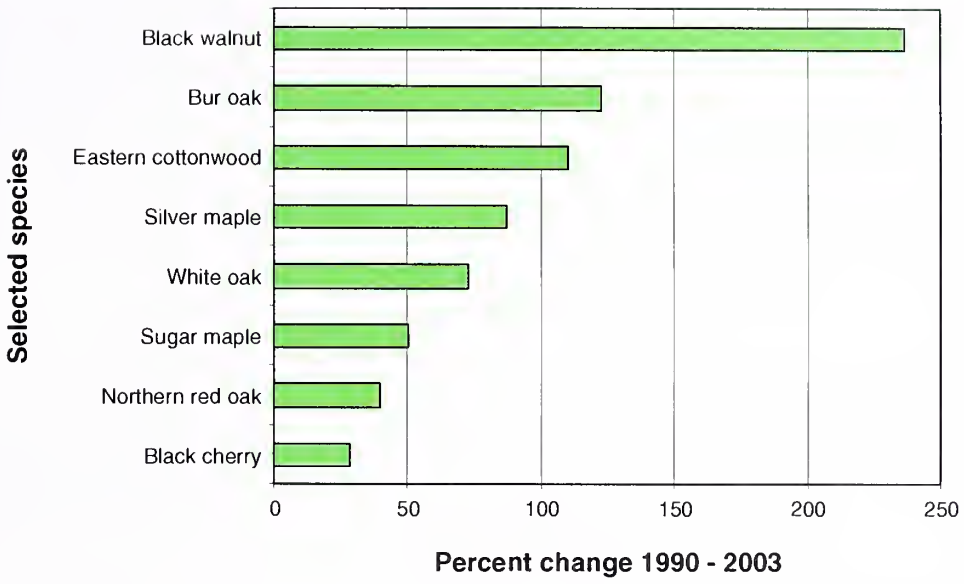


Figure 3.7. Percent change in total sawtimber volume on Iowa timberland for selected species, 1990 to 2003.



Timber Products Output

Background:

Through the process of converting harvested trees into products such as lumber, veneer, or pulp, Iowa's forest resource provides income to both woodland owners and wood-processing mills. To better understand the effects of the primary wood use and manufacturing sector on the economy and its impacts on forests, it is important to monitor timber products outputs.



What We Found:

We survey Iowa's wood-processing mills periodically to estimate the amount of wood volume that is processed into products. The two most recent surveys were conducted in 1994 (Piva 1997) and 2000 (Piva and Michel 2003). In 2000, there were 59 primary wood-processing mills in Iowa—57 sawmills, 1 pulp mill, and 1 veneer mill (fig. 3.8). Sawmills declined by 12 between 1994 and 2000, while the number of veneer and pulp mills remained unchanged. In 2000, primary mills in Iowa processed 19.9 million ft^3 of industrial roundwood, an increase of nearly 7 percent over 1994. Less than 1 percent of the industrial roundwood processed was softwood. Nearly three-fourths (14.2 million ft^3) of the industrial roundwood processed was cut from Iowa's woodlots and forests. The remaining 28 percent (5.7 million ft^3) was imported, mostly from surrounding states.

Saw logs accounted for 88 percent of the total industrial roundwood produced in 2000, followed by pulpwood at 8 percent and veneer logs at 4 percent (fig. 3.9). Iowa's forests provided 88.6 million board feet of saw logs to sawmills in Iowa and adjacent states. Mills in adjacent states processed 14.6 million board feet of saw logs from Iowa. Overall, saw log production fell by 118,000 board feet, or less than 1 percent, between 1994 and 2000. Increases in saw log production among black walnut, red oak, white oak, and soft maples were offset by losses in production from cottonwood and basswood (fig. 3.10). Veneer log production increased from 2.8 million board feet in 1994 to 3.6 million board feet in 2000, a 27-percent increase. Black walnut and white oak accounted for 70 percent of the veneer log production in 2000. However, veneer production declined for both white and red oak. Pulpwood production increased by 63 percent, from 10,000 cords in 1994 to 17,000 cords in 2000. Cottonwood accounted for 44 percent of the volume harvested for pulpwood in 2000.

What This Means:

Nearly all the wood-processing facilities in Iowa are sawmills processing State-grown saw logs. These mills provide woodland owners with an outlet to sell timber and provide jobs in some of the State's rural areas. The demand for wood products is likely to increase, placing greater demand on the hardwood resource. An important consideration for the future of Iowa's primary wood-products industry is its ability to procure high quality wood and deliver products that will lead to value-added production in the State. Currently, some saw logs are shipped to out-of-state mills for processing, providing less benefit to Iowa's economy. And the continued availability of high-quality red and white oak saw logs is problematical because sawtimber volume for those species is showing only modest increases while saw log production remains relatively high. Absent sufficient oak regeneration, timber products output from those species could decline.

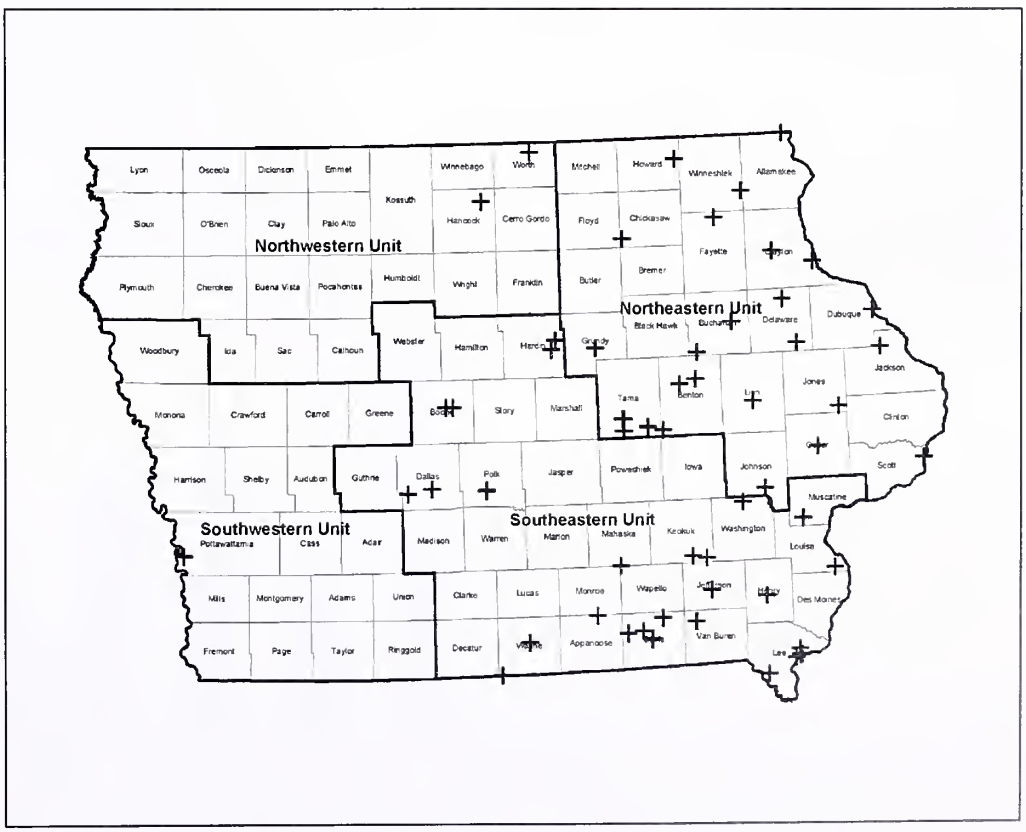


Figure 3.8. Location of primary wood-processing mills by region, Iowa, 2000.

Figure 3.9. Industrial roundwood production by product produced, Iowa, 2000.

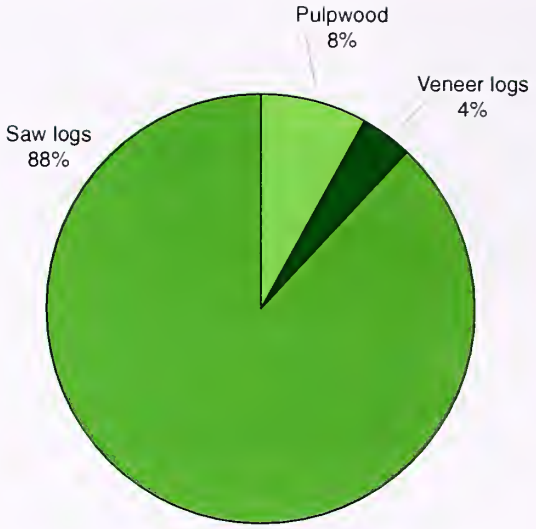
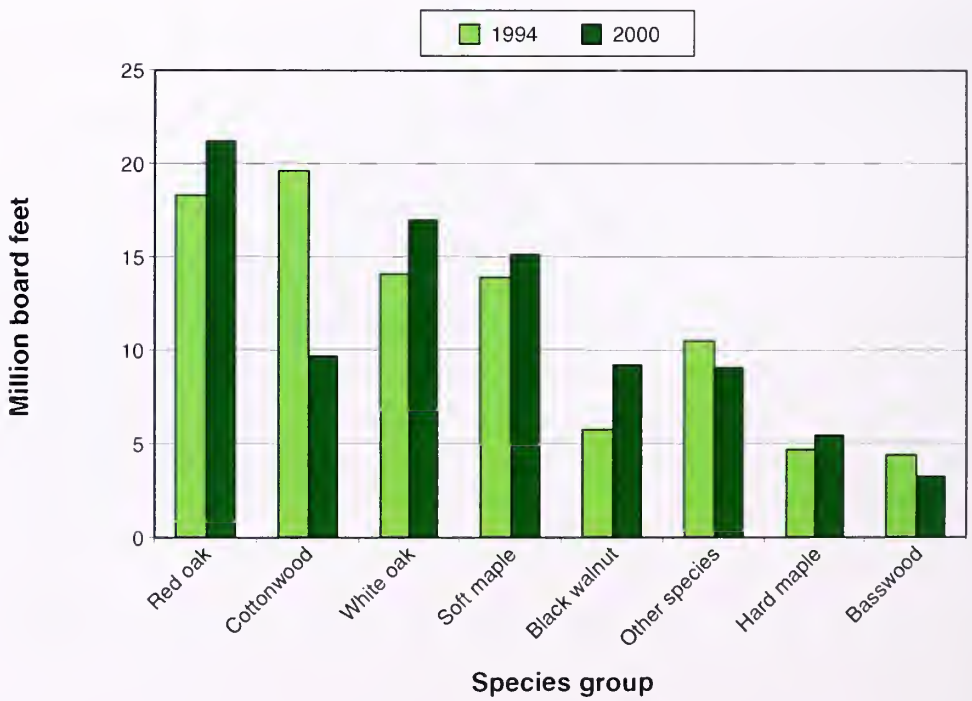


Figure 3.10. Saw log production by species group, Iowa, 1994 and 2000.



Wildlife Habitat

Background:

Iowa's woodlots and river bottom forests are important habitat for wildlife. The combination of forest features form the environment in which wildlife species find suitable conditions for reproducing, feeding, and resting. The State's oak/hickory forests have high wildlife values because acorns are a dietary staple of many animals and birds.

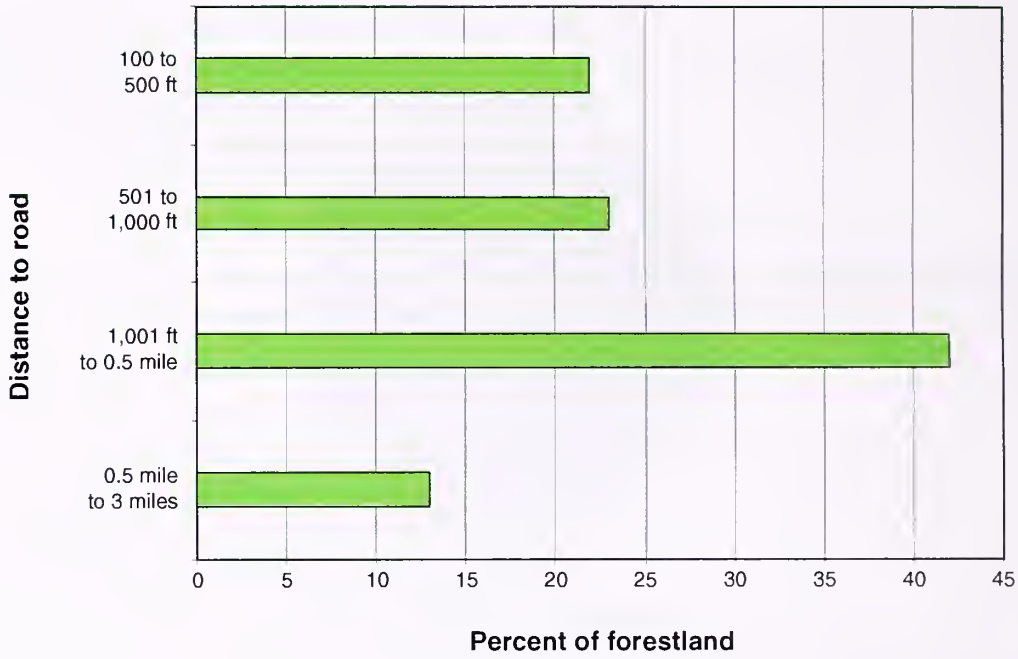
What We Found:

Iowa's forests, which provide habitats for more than 300 species of wildlife, comprise mature stands with distinct vertical layers—ground and shrub layers, and canopy. Each layer provides food, cover, nesting, and resting sites for different species of wildlife, and within each vertical layer are trees of various forms. The typical wooded acre has 391 live trees, 109 rough trees, 10 standing dead trees, 4 rotten trees, and various types of down woody debris. The larger live trees produce copious annual crops of mast and seeds, and each tree form along with woody debris provide microhabitats that are used by wildlife. The habitat requirements of many wildlife species include being at a distance from human populations to reproduce. Although Iowa's forests are in small tracts, more than half of the area is more than 1,000 feet from the nearest road (fig. 3.11). Woodland owners, both private and public, manage some forests for wildlife. The National Woodland Owner Survey (Butler and Leatherberry 2005) revealed that Iowa's family forest owners are active in wildlife-related activities. In the last 5 years, wildlife or fisheries improvement projects have been initiated on 17 percent (283,000 acres) of woodland held by family forest owners. For these owners, hunting and fishing are primary reasons for owning forest lands. The Iowa Department of Natural Resources manages 340 wildlife areas totaling more than 270,000 acres. This acreage contains diverse habitat types, including wetland, grassland, forest land, and agricultural crops. The Upper Mississippi River National Wildlife and Fish Refuge is an important publicly owned wildlife habitat resource.

What This Means:

Their composition and structure make Iowa's mature forests suitable as habitat for a variety of wildlife species. Oak-hickory woodlots and wooded stream bottoms amid croplands and pastures attract species that prefer forest edges. For instance, the white-tailed deer has flourished to the point that some Iowans are concerned about their population. The nature of trees in a stand influences the mix of wildlife. For instance, rotten and standing dead trees are essential for cavity-nesting birds and are used as a perch by raptors. Large blocks of forests are rare in Iowa. Continued forest fragmentation, where these blocks are carved into ever smaller pieces, likely will reduce habitat for some species but also lead to an increase in deer and other species attracted to forest edges.

Figure 3.11. Percentage of forest area by distance to road, Iowa, 1999-2003.



Forest-Based Recreation and Tourism

Background:

Forests provide economic and social benefits throughout the State by improving the quality of life through recreation opportunities resulting from a diverse landscape. Forest-based recreation and tourism create economic activity and are important for attracting and retaining employees and retired people.

What We Found:



Photo courtesy of USDA Natural Resources Conservation Service

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDI Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census 2001) provides insight into the importance of forest-based recreation and tourism to Iowa's economy. In 2001, more than 1 million individuals at least 16 years old participated in wildlife-watching activities, including observing, feeding, and photographing wildlife. Forests often were the setting for these activities. Nine of every 10 individuals who engaged in wildlife-watching live in the State. Wildlife watchers spent $188.4 million on this activity in 2001 (fig. 3.12a), an average of $184 per participant. Between 1991 and 2001, the number of wildlife-watching participants increased. In 2001, about 243,000 people hunted in Iowa for an average of 16 days. Hunters spent $167 million on equipment and trip-related expenses (fig. 3.12b). The average hunter spent $680 during the year. Pheasants are highly prized game birds in Iowa and pheasant hunters contribute a large share of the money generated from hunting. More than 500,000 people fished Iowa's waters that often are associated with forested areas. Anglers averaged 14 days of fishing in 2001 while spending over $336 million on trip-related expenditures for equipment, boat fuel, and licenses (fig. 3.12c). The average angler spent $438 during the year. Forest-based tourism is important to local communities throughout Iowa, particularly those along the Great River Road and the Loess Hills Scenic Byway. Both roads, nationally designated, attract visitors interested in viewing tree fall foliage and spring blooming of wildflowers.

What This Means:

There are indicators that point to a decline in the number of people who hunt in Iowa. Broad demographic changes related to increased urbanization, an aging population, and limited access to privately owned hunting lands could further reduce the number of hunters, resulting in reduced economic activity from that activity. However, wildlife viewing and other nonconsumptive forest-based recreation activities are increasing in Iowa.

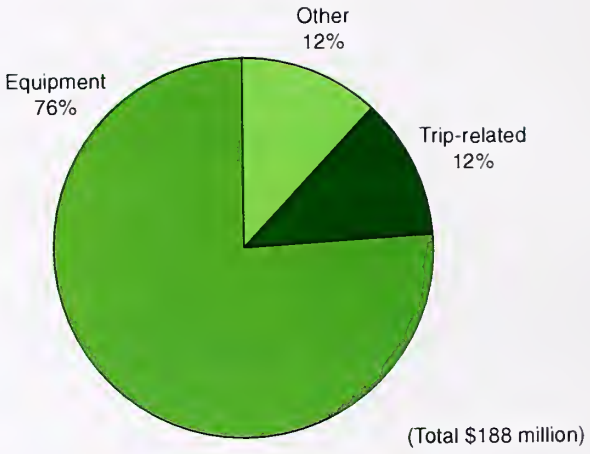


Figure 3.12a. Wildlife-watching expenditures in Iowa, 2001.

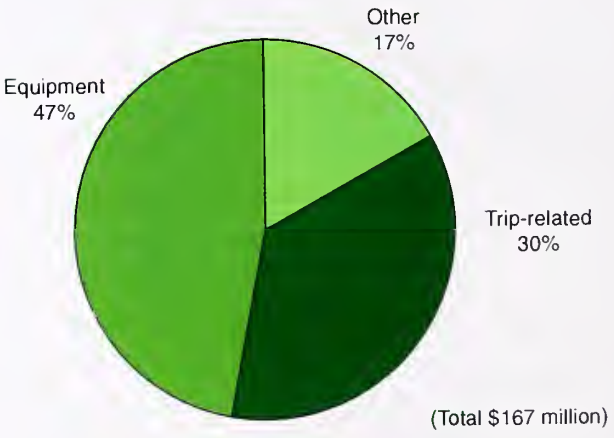


Figure 3.12b. Hunting expenditures in Iowa, 2001.

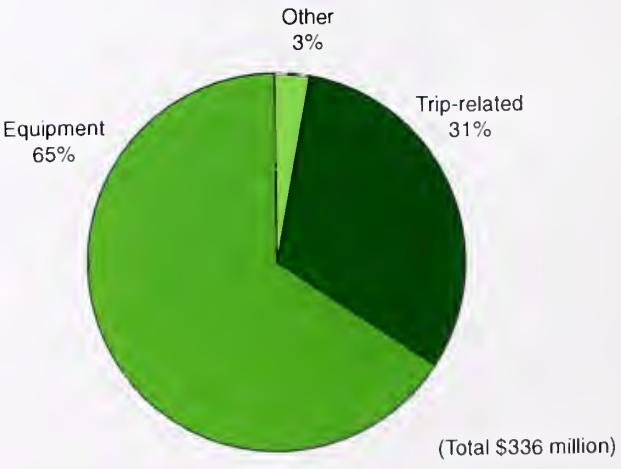


Figure 3.12c. Fishing expenditures in Iowa, 2001.

Source: U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau, 2001.

Data Sources and Techniques



Data Sources and Techniques

Forest Inventory

Information on the condition and status of forests in Iowa was obtained from the North Central Research Station's Forest Inventory and Analysis (NCFIA) program. NCFIA began fieldwork for the fourth forest inventory of Iowa's forest resources in 1999. This inventory launched the new annual inventory system by which one-fifth of the field plots (considered one panel) are measured each year. In 2003, NCFIA completed measurement of the fifth and final panel of inventory plots in Iowa. Now that all panels have been measured, each will be remeasured approximately every 5 years. Previous inventories of Iowa's forest resource were completed in 1954, 1974, and 1990.

National Woodland Owner Survey

Information about family forest owners was obtained from the National Woodland Owner Survey (NWOS) sponsored by the USDA Forest Service's Forest Inventory and Analysis (FIA) program. Initiated in 2002, NWOS is designed to increase our understanding of private forest land owners in the United States and enable policymakers, resource managers, and others interested in the Nation's forest resources to better understand the social context of forests and formulate more informed opinions and decisions. The people identified by the FIA forest inventory as private forest land owners formed the sample for the NWOS. Every year, a different set of approximately 6,500 owners from across the country are invited to participate in the NWOS. Data are gathered via a mailed questionnaire and divided into the following categories: (1) forest land characteristics, (2) ownership objectives, (3) forest use, (4) forest management, (5) sources of information, (6) concerns and issues, and (7) demographics. For details about the methods used to design, implement, and process the data for the NWOS visit: www.fs.fed.us/woodlandowners. Summary findings from the NWOS also are available at this Web site.

Forest Health Monitoring Program

Information about insects and disease was obtained from the Forest Health Monitoring program (FHM); which determines the status, changes, and trends in indicators of forest condition on an annual basis. The FHM program uses data from ground plots and surveys, aerial surveys, and other biotic and abiotic data sources and develops analytical approaches for addressing forest health issues that affect the sustainability of forest ecosystems. FHM covers all forested lands through a partnership that includes the USDA Forest Service, State Foresters, and other State and Federal agencies and academic groups. Major FHM activities include detection, evaluation, and intensive site monitoring, research on monitoring techniques, and analysis and reporting. For details about the FHM program and forest health highlights visit: http://fhm.fs.fed.us/.

Iowa Woodland Invasive Species Inventory

Some of the information about invasive plant species in Iowa was obtained from the Iowa Woodland Invasive Species Inventory, a component of the North Central Plan for Documentation and Awareness of Invasive Plants Impacting Forests. The Plan was initiated in 2002 by the USDA Forest Service's Northeastern Area, State and Private Forestry. The inventory, managed by the Iowa Department of Natural Resources and Iowa State University, is designed to document the current locations and severity of key invasive woodland species in the State. The goals of the program are to map the distribution and severity of the four major invasive plants found in forests within the North Central Region and increase public awareness about invasive species. Volunteers are used to collect and report the data needed to develop a strategy for managing invasive species. This monitoring project is a cooperative effort among Iowa Department of Natural Resources Division of Forests and Prairies, Iowa State University's Department of Forestry and Forestry Extension and Department of Animal Ecology, the Iowa NatureMapping Program, and the Northeastern Area, State and Private Forestry. For additional information about the Iowa Woodland Invasive Species Inventory visit: http://www.nrem.iastate.edu/Invasive_Species/Invasives.html or contact the Iowa Department of Natural Resources.

Timber Products Output and Use Assessment

Information about timber products output and use was obtained from the 2000 Iowa Timber Product Output and Use Assessment study, a cooperative effort among the NCFIA and the Iowa Department of Natural Resources, Bureau of Forestry. Using a questionnaire designed to determine the size and composition of Iowa's forest products industry, its use of roundwood (round sections cut from trees), and its generation and disposition of wood residues, Bureau of Forestry personnel visited all primary wood-using mills within the State. Completed questionnaires were sent to NCFIA for editing and processing. As part of data editing and processing, all industrial roundwood volumes reported on the questionnaires were converted to standard units of measure using regional conversion factors. Timber removals by source of material and harvest residues generated during logging were estimated from logging utilization studies previously conducted by NCFIA.

National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, Iowa, 2001

Information on forest-based recreation and tourism was obtained primarily from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey which has been conducted since 1955 to gather data on the number of anglers, hunters, and wildlife-watching participants in the United States. Information is also collected on how often these recreationists participate and how much they spend on their activities. For more information about the survey or to receive a copy of the Iowa report, visit: http://www.census.gov/prod/www/abs/fishing.html.

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About the Authors:

Earl C. Leatherberry (retired) was a Resource Analyst with the Forest Inventory and Analysis work unit, North Central Research Station, St. Paul, Minnesota.

W. Keith Moser is a Research Forester with the Forest Inventory and Analysis work unit, North Central Research Station, St. Paul, Minnesota.

Charles H. (Hobie) Perry is a Research Soils Scientist with the Forest Inventory and Analysis work unit, North Central Research Station, St. Paul, Minnesota.

Christopher Woodall is a Research Forester with the Forest Inventory and Analysis work unit, North Central Research Station, St. Paul, Minnesota.

Edward Jepsen is a Plant Pest and Disease Specialist with the Wisconsin Department of Natural Resources, Madison, Wisconsin.

Steve Pennington (retired) was the Forest Health Forester for the Iowa Department of Natural Resources – Forestry Bureau stationed in Ames.

Aron Flickinger is the Forest Health Forester for the Iowa Department of Natural Resources – Forestry Bureau stationed in Ames.

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The first completed annual inventory of Iowa's forests reports more than 2.6 million acres, nearly matching what was present in 1954. Most of Iowa's forest stands are fully or moderately stocked, suggesting that for the near term stands are capable of supplying timber for the State's wood products industry. The increasing number of shade-tolerant species may lead to less tree species diversity in Iowa's forest stands in the future, as shade-intolerant species are no longer able to compete in a more shady environment. Many oak-dominated stands are at the successional stage where harvest is economically advantageous, yet they contain a greater proportion of area in the older age classes. Annual net growth of growing stock has more than doubled since the 1980s. The lack of significant disturbances in hardwood stands has not adequately opened stands to necessary seedling development. As fewer young oak move up in age, mast-dependent wildlife species may decline.

KEY WORDS: forest inventory, forest health, Iowa.

Published by:
North Central Research Station
Forest Service
U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, MN 55108
2006

Web site: www.ncrs.fs.fed.us

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